FORAMINIFERA OF THE WEBBERVILLE FORMATION IN TEXAS

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THESIS

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By

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PREFACE

The study of the Foraminifera is by no means new. Concerning this group of the Protozoa, literature embracing numerous phases from descriptions of species to explanations of life cycles and evolutionary development may be found. Until the last few years, however, but little detailed investigation has been made of the micro-fauna of the various geologic horizons. There have been published one bulletin and several short articles based on the foraminifera of the Cretaceous formations in Texas. A few short papers dealing with the faunule of some of the Pennsylvanian formations in this state have appeared within the last year and an excellent bulletin on the foraminifera of the Midway formation is obtainable. The need for more extensive work on the micro-organisms of the Upper Cretaceous in Texas has been apparent for a long time and it was with that need in view that I chose my subject.

My purpose shall be two-fold; first, to describe and figure as many foraminifera of the Webberville formation as are fairly common, or which are especially diagnostic of that formation; and, second, to attempt to place important forms in the beds with as much exactness as present knowledge permits.

I wish to express special appreciation to Professor F. L. Whitney of the Department of Geology in the University of

Texas, under whose direction this thesis has been prepared, and who has given valuable advice as well as aid in securing samples and in photographing foraminifera.

Many of the photographs were taken from the following books: Foraminifera of the Midway Formation in Texas, by Helen Jeanne Plummer; Foraminifera of the Cretaceous of Central Texas, by Dorothy Ogden Carsey; Contributions from the Cushman Laboratory for Foraminiferal Research.

Through the kindness of Dr. E. H. Sellards, who allowed me the use of the library of the Bureau of Economic Geology, I was enabled to consult several valuable old publications.

To Robert H. Cuyler I am indebted for helpful suggestions concerning the identification of several specimens and the preparation of slides for the preservation of the collection.

I wish also to thank David C. Harrell who helped me to secure samples from the upper beds of the Webberville formation.

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INTRODUCTION

The uppermost beds of the Cretaceous in Texas, known as the Webberville formation in the vicinity of Austin, are composed largely of dark blue-grey and black clay marls. Much sand, some sandstone layers, and impure limestone are to be found in the upper portion; the amount of each diminishes until little or none are found in the lower part. The sand grains are, in general, angular to subangular in shape, sometimes showing evidence of wear. Hexagonal crystals of clear quartz, terminated by positive and negative rhombohedrons, are found rarely in the upper sandy layers. Gypsum occurs throughout the formation but it is especially abundant in the lower strata. Glauconite is not so abundant in the Webberville as in the overlying Midway and it does not occur at all in the underlying Taylor. Due to its iron content the Webberville weathers to a yellowish brown somewhat resembling weathered Midway clays. In the field the two may be difficult to distinguish where large fossils are absent. With the aid of a hand lens, however, certain large microfossils can be used to differentiate between them.

Good exposures of Webberville are rare. The whole formation is covered in most places with a residual soil so that in collecting samples extreme care must be taken in order to get material that is in place. A complete vertical section cannot be obtained at any one locality.

Since many of the forms present in the Webberville occur also in the Midway and in the Taylor, it is essential that the worker have a somewhat detailed knowledge of each of these formations in order that the diagnostic forms may be separated.

In contrast to the Webberville the Midway is characterized by a dominance of species belonging to the families Lagenidae and Rotalidae. Diagnostic species of the Taylor formation are also members of these families.

The problem of names in the Lagenidae is one of the most baffling in all the families of the foraminifera. The members of this family represent a very plastic group so that distinctions in it are much more difficult to make than in most others.

With reference to the partially coiled and coiled forms, Dr. Joseph A. Cushman endeavors to keep to the genera Robulus, Lenticulina, Marginulina, and Saracenaria and to fit into those four all the forms possible. Since it is obvious that much more time must be spent on this difficult phase of nomenclature before the question can be settled, I have retained the old generic name, Cristellaria, for those specimens which did not, to my mind, fit with ease into any one of the four generic names with which Dr. Cushman proposes to replace Cristellaria, until such time as more detailed investigation can be made.

Ninety feet of the upper portion of the Webberville are exposed in steep, low bluffs along Onion Creek. Southeastward from Austin, in the region through which Dry Creek runs, south and

east from Moore and Berry's store, Webberville may be collected in the gullies formed by heavy rains. This area is cut by numerous small faults and it is, therefore, difficult to place any part of it in the section, but it is probably upper Webberville. Farther south, in Hays and Caldwell Counties, beginning in the vicinity of Niederwald and following the main road to Lockhart, a fairly complete section with apparently little or no faulting can be secured. East and slightly north of Austin are other exposures of Webberville. Ecologically the formation is an open prairie except where a growth of mesquite is found.

While only about one-third of the forty-five families of the foraminifera are represented, the Webberville clays carry a rich and well preserved faunule, most of which is unmineralized. The abundance and beauty of its tests are surpassed only by those of the Midway. In wealth of specimens the families Heterohelicidae and Globigerinidae dominate, but in the number of different species the family Lagenidae excels. The families Buliminidae and Rotalidae also furnish considerable numbers. The upper sandy layers are characterized by members of the families Trochamminidae and Lituolidae. These arenaceous forms make up almost the entire faunule in certain horizons.

WEBBERVILLE SECTION FROM A POINT BETWEEN

NIEDERWALD AND UHLAND TO LOCKHART

Base	Barometer	Spedometer	Time
Sta. 1	293	83.2	9:27 A.M.
Sta. 2	250	83.29	9;40 A.M.
Sta. 3	225	83.90	9:47 A.M.
Sta. 4	240	84.00	9:57 A.M.
Sta. 5	225	84.50	10:03 A.M.
Sta. 6	250	84.75	10:10 A.M.
Sta. 7	230 240	84.95	10:18 A.M.
Sta. 8	230	85.40	10:24 A.M. 10:27 A.M.
Sta. 9	245	85.70	10:32 A.M. 10:39 A.M.
Sta. 10	280	86.10	10:44 A.M. 10:52 A.M.
Sta. 11	290	86.50	10:55 A.M.
Sta. 12	293	86.50	11:06 A.M.
Sta. 13	295 300	86.50	11:07 A.M. 11:11 A.M.
Sta. 14	285	87.55	11:17 A.M.
Sta. 15	240	88.40	11:26 A.M. 11:32 A.M.
Sta. 16	290	88.95	11:37 A.M.
Sta. 17	320	89.35	11:47 A.M.

The Lockhart road was entered at the county line.

The spedometer reading at this point was 83.75 miles.

Sta. 8. Sandstone beds.

Sta. 9. Limestone beds and clay beds with Gryphaea vesicularis, Exogyra costata, Cucullaea tippana, Crassatilites sp., contained in the clays.

Just above the clays, possibly five feet, is ripple-marked sandstone.

Sta. 10. Clay beds (sandy).

Sta. 11. Clay with sandy lime and Aphrodina.
Sta. 12. See Previous Page
Sta. 13. Sandstone beds. Dip 6° 30' south.

Sta. 14. At the Tank at the bend of the road, sandstone beds.

Sta. 15. Sandstone beds and conglomerates.

Sta. 16. Sandy lime beds with sandy clay wash at road fork to the right in the Valley. A house on the hill ahead.

The lime rocks contain Exogyra, Ostrea, etc.

Sta. 17. Material from Tank on hill. Probably Midway.

DESCRIPTION OF THE SPECIES

Family REOPHACIDAE

Genus REOPHAX Montfort, 1808

REOPHAX TEXANA Cushman and Waters

Pl. I, fig. I

(Plesiotype- Univ. of Texas Geol. Coll. 1)

Reophax texana Cushman and Waters, 1927, Contrib. Cushman Lab. Foram. Res., Vol. II, Part IV, p. 82, pl. 10, fig. 2.

Test elongate, tapering, extremities rounded; chambers full, subspherical; sutures straight, depressed; wall coarsely arenaceous, sand grains angular, little cement; usually brown in color; aperture terminal, central.

Length up to 1.25 mm.; diameter 0.50 mm.

This species is most abundant in the upper sandy layers of the Webberville, but it is found widely distributed throughout the formation. It breaks easily at the sutures so that perfect specimens are rare. R. texana has not been reported from any other formation.

Locality: Travis County, about three and one half miles southeast of Moore and Berry's store- Sta. 1.

Family AMMODISCIDAE

Genus AMMODISCUS Reuss, 1861

AMMODISCUS INCERTUS (d'Orbigny)

Pl. I, Fig. 2

(Plesiotype- Univ. of Texas Geol. Coll. 2)

Operculina incertus d'Orbigny, 1839, Foram. Cuba, p. 71, pl. 6, figs. 16, 17.

Spirillina arenacea Williamson, 1858, Rec. Foram. Gr. Brit., p. 93, pl. 7, fig. 203.
Trochammina incerta H. B. Brady, 1876, Challenger, Vol. 9 (Zool.), p. 330, pl. 38, figs. 1-3.
Ammodiscus incertus Sherborn and Chapman, 1889, Jour. Roy. Mic. Soc., p. 484, pl. II, fig. 7.
Ammodiscus incertus Chapman, 1892, Jour. Roy. Mic. Soc., p. 326, pl. 6, fig. II.
Ammodiscus incertus Burrows and Holland, 1897, Proc. Geol. Assoc., Vol. 15, p. 31.
Ammodiscus incertus Flint, 1899, Rpt. U. S. Nat. Mus., for 1897, p. 278, pl. 23, fig. 2.
Ammodiscus tenuis Id., 1899, Ibid., p. 279, pl. 23, fig. I.
Ammodiscus incertus Cushman, 1910. U. S. Nat. Mus. Bull. 71, pt. I, p. 73, text figs. 95, 96.
Ammodiscus incertus Id., 1921, U. S. Nat. Mus. Bull. 100, Vol. IV, p. 62, pl. 5, figs. 1, 2.

Test elliptical in outline, composed of a globular proloculum and a long, slender, non-septate tube, gradually increasing in diameter, coiled in a planospiral manner, biconcave, periphery rounded; wall very finely arenaceous, with much cement, smooth; aperture simple, formed by the open end of the tube; white.

Diameter up to 0.60 mm.

The typical round discoidal test is rare in the Webberville but peripherally compressed specimens are moderately common. Both megalospheric and microspheric forms are present. The latter are more abundant. A. incertus occurs in the Taylor also. Midway forms of this species are usually microspheric and larger than the Cretaceous specimens. In the upper portion of this formation they are often accompanied by Textularia eocaena (Gumbel) and Haplophragmoides canariensis (d'Orbigny).

Some of the Pennsylvanian formations in Texas have yielded this same species of Ammodiscus.

Locality: Travis County, Onion Creek, near Del Valle - 15 feet above the water's edge.

Family LITUOLIDAE

Genus HAPLOPHRAGMOIDES Cushman, 1910

HAPLOPHRAGMOIDES EXCAVATA Cushman and Waters

Pl. I, fig. 3

(Plesiotype- Univ. of Texas Geol. Coll. 3)

Haplophragmoides excavata Cushman and Waters, 1927, Contrib. Cushman Lab. Foram Res., Vol. II, Part IV, pp. 82, 83, pl. 10, figs. 3 a, b.

Test subspherical in outline, planospiral, close-coiled, faintly umbilicate, thickest in the center, somewhat compressed toward the periphery which is subacute, thickened, and slightly lobulated; chambers depressed centrally and distinctly thickened at the margins, 10 visible; sutures straight, radial; wall very finely arenaceous, little cement; very light grey to white.

Length 0.45-0.50 mm.; breadth 0.35-0.40 mm.; thickness 0.15-0.18 mm.

This species is characteristic of the upper Webberville. It may be practically the only species present in certain zones while in others it may be accompanied by various other arenaceous forms.

Locality: Caldwell County, road from Niederwald to Lockhart - Sta. 14.

HAPLOPHRAGMOIDES COMPLANATA n. sp.

Pl. 4, fig. 1

(Holotype- Univ. of Texas Geol. Coll. 4)

Test not completely involute, about one and one-half convolutions visible, planospiral, compressed, periphery subacute, slightly lobulated; chambers numerous, indistinct in most specimens, averaging 10 to the last whorl, central portion sometimes more or less depressed, the thickened margins forming a semicircular ridge about the inner whorl on one side; sutures usually vague, straight, radial, slightly depressed; wall of moderately coarse, angular sand grains and considerable cement; brown.

Length 1.7 mm.; breadth 1.5 mm.; thickness 0.15 mm.

This species is found in moderate abundance in samples from the upper Webberville. It occurs in neither the overlying nor the underlying formations.

Locality: Travis County, Onion Creek, near Del Valle- 55 feet above the water's edge.

HAPLOPHRAGMOIDES CONVOLUTA n. sp.

Pl. 4, fig. 2

(Holotype- Univ. of Texas Geol. Coll. 5)

Test planospiral, one and one-half convolutions visible, somewhat compressed, periphery subacute; chambers gradually increasing in size, 9 to 10 in the last formed whorl, usually rather indistinct; sutures straight, radial, not distinct;

wall composed of coarse, angular sand grains with considerable cement.

Length 1.45 mm.; breadth 0.75- 0.80 mm.; thickness 0.16 mm.

The upper sandy layers of the Webberville frequently contain this species.

Locality: Travis County, about three and one-half miles southeast of Moore and Berry's store- Sta. 2.

Family TEXTULARIIDAE

Genus TEXTULARIA Defrance, 1824

TEXTULARIA SEMICOMPLANATA Carsey

Pl. 1, fig. 4

(Plesiotype- Univ. of Texas Geol. Coll. 6)

Textularia semicomplanata Carsey, 1926, Univ. of Texas Bull. 2612, p. 25, pl. 3, fig. 4.

Test subtriangular, laterally compressed, thickest along the median line, apertural and broad and straight, initial and bluntly pointed, margins straight, narrow, thin; chambers numerous, low, broad, biserially arranged; sutures raised, curved slightly upward, nearly at right angles to the periphery; wall finely arenaceous; aperture oval, located at the base of the final chamber.

Length about 0.50 mm.; width at widest portion about 0.40 mm.

T. semicomplanata is found sparingly throughout the Webberville and in the Taylor.

Locality: Travis County, Onion Creek, near Del Valle- 10 feet above the water's edge.

Family VERNEUILINIDAE

Genus GAUDRYINA d'Orbigny, 1839

GAUDRYINA BULLETA Carsey

Pl. 1, fig. 5

(Plesiotype- Univ. of Texas Geol. Coll. 7)

Gaudryina bulleta Carsey, 1926, Univ. of Texas Bull. 2612, p. 28, pl. 4, fig. 4.

Test elongate, tapering but rather stout, cylindrical to subcylindrical in transverse section, proximal and rounded, distal and more or less flattened; chambers low and broad, initial ones triserial, later ones, making up four-fifths of the test, biserial; sutures straight, at right angles to the periphery, easily discernible in the later portion but indistinct in the early portion; wall very finely arenaceous, smooth; aperture elongate, narrow, lying at the base of the final chamber.

Length 0.7 mm.

This species is sparingly common in the Webberville formation. It makes up a part of the scanty faunule of the upper beds. It is also present in the Taylor marl.

Locality: Travis County, Onion Creek, near Del Valle- 10 feet above the water's edge.

GAUDRYINA PUPOIDES d'Orbigny

Pl. 2, fig. 1

(Plesiotype- Univ. of Texas Geol. Coll. 8)

Gaudryina pupoides d'Orbigny, 1840, Mem. Soc. Geol. France, Ser. I, Vol. IV, p. 44, pl. 4, figs. 22-24.

Test elongate, tapering toward the proximal end, rounded at the apertural end, slightly compressed, oval in cross section, margins rounded; early chambers triserial, somewhat compressed to form a slight ridge on one side of the test; later chambers, making up four-fifths of the test, textularian, drooping, a little broader than high, last chamber larger than the others; sutures straight, oblique, faintly depressed, distinct in the later portion but hardly visible in the initial portion; wall moderately coarsely arenaceous; aperture oval, edges rounded, situated at the base of the final chamber.

Length about 0.82 mm.

G. pupoides is moderately common in the Webberville, especially in the lower portion, as well as in the Taylor. It has been found in no other formation in Texas.

Locality: Travis County, Onion Creek, near Del Valle- 10 feet above the water's edge.

GAUDRYINA RUGOSA d'Orbigny

Pl. 2, fig. 2

(Plesiotype- Univ. of Texas Geol. Coll. 9)

Gaudryina rugosa d'Orbigny, 1840, Mem. Soc. Geol. France, Ser. I, Vol. IV, p. 44, pl. 4, figs. 20, 21.

Gaudryina rugosa Reuss, 1856, Sitz. k. Akad. Wiss. Wien, Vol. XVIII, p. 244, pl. 5, fig. 61.
Gaudryina rugosa Brady, 1884, Challenger, p. 381, pl. 44, figs. 14-16.
Gaudryina rugosa Flint, 1899, Rpt. U. S. Nat. Mus., for 1897, p. 288, pl. 33, fig. 3.

Test elongate, triangular in cross section, sometimes slightly twisted on the long axis, margins acute in the early portion, rounded in the later portion; initial chambers triserial, occupying a very short portion of the test, later ones biserial, final chamber sometimes almost central, produced and rounded; sutures oblique, depressed; wall moderately coarsely arenaceous; aperture small, round, at the base of the last chamber.

Length 0.85- 0.90 mm.

This species occurs sparingly in the upper beds of the Webberville and has not been found in any other geological horizon in Texas.

Locality: Caldwell County, on the road from Niederwald to Lockhart- Sta. 14.

CLAVULINA TRIQUETRA Reuss

Pl. 2, fig. 3

(Plesiotypes- Univ. of Texas Geol. Coll. 10)

Clavulina triquetra Reuss, 1864, Denkschr. k. Akad. Wiss. Wien, Vol. XXIII, p. 6, pl. I, fig. I.

Test rather large, elongate, triangular in cross section, microspheric form about the same width throughout, the more

typical megalospheric form wider toward the broadly rounded oral end, aboral end in both obtuse, periphery tricarinate; chambers numerous, narrow, triserially arranged in the short, early portion, uniserial in the later portion; sutures distinct, depressed, oblique in the triserial portion, at right angles to the longitudinal axis and curved upward in the uniserial portion; wall very finely arenaceous; apertural face triangular; aperture terminal, central, subtriangular, slightly protruding.

From the Midway form, C. angularis d'Orbigny, C. triquetra may be distinguished by its smoother shell wall, its more distinct sutures, and its sharper, less broken margins.

The Webberville carries many of this clavuline species distributed throughout the formation.

Locality: Travis County, Onion Creek, near Del Valle- 10 feet above the water's edge.

Family MILIOLIDAE

Genus QUINQUELOCULINA d'Orbigny

QUINQUELOCULINA SEMINULUM (Linnaeus)

Pl. 2 fig. 4

(Plesiotypes- Univ. of Texas Geol. Coll. 11)

Serpula seminulum Linnaeus, 1767, Syst. Nat., ed. 12, p. 1264, No. 791.
Quinqueloculina seminulum d'Orbigny, 1826, Ann. Sci. Nat., Vol. VII, p. 303, No. 44.

Miliolina seminulum Williamson, 1858, Rec. Foram. Gr. Brit., p. 85, pl. 7, figs. 183-185.
Quinqueloculina seminulum Parker, Jones, and Brady, 1866, Crag. Foram., Pal. Soc., Vol. XIX, p. 9, pl. 3, figs. 35, 36.
Miliolina seminulum Brady, 1884, Challenger, Vol. IX, p. 157, pl. 5, figs. 6 a-c.
Miliolina seminulun Heron-Allen and Earland, 1915, Trans. Zool. Soc., Vol. XX, p. 569, pl. 42, fig. 31.
Quinqueloculina seminulum Cushman, 1917, U. S. Nat. Mus. Bull. 71, Part Vi, p. 44, pl. II, fig. 2, fig. 29 (text).

Test subovate to rounded in outline, roughly triangular in transverse section, periphery rounded; five chambers always visible, four may be seen on one side and three on the other; chambers long, half a coil in length, growing longer with age, curved subtriangular in cross section; sutures distinct, depressed, partially filled with white cementing material; shell smooth, clear; aperture formed by the open end of the last chamber, subtriangular.

Length 0.45- 0.50 mm.

This quinqueloculine species is fairly common in the Webberville.

Locality: Travis County, Onion Creek, near Del Valle- 35 feet above the water's edge.

Family TROCHAMMINIDAE

Genus TROCHAMMINA Parker and Jones, 1860

TROCHAMMINA DIAGONIS (Carsey)

Pl. 2, fig. 5

(Plesiotype- Univ. of Texas Geol. Coll. 12)

Haplophragmoides diagonis Carsey, 1926, Univ. of Texas Bull. 2612, p. 22, pl. 3, fig. I.

Trochammina diagonis Cushman, 1927, Contrib. Cushman Lab. Foram. Res., Vol. II, Part IV, p. 84, pl. 10, figs. 7 a-c.

Test trochoid, about two and one-half convolutions visible, compressed, periphery subacute, distinctly lobulated; chambers distinct, 6 to 9 in the last whorl which lies slightly below the preceding one; sutures distinct, slightly curved dorsally, straight ventrally; wall arenaceous, with considerable cement.

Diameter 0.65- 0.80 mm.

This species is characteristic of the upper Webberville where it often appears as an irregular form due, probably, to shearing within the formation. It, however, has been observed in the Taylor.

Locality: Travis County, Onion Creek, near Del Valle- 75 feet above the water's edge; Caldwell County, on the road from Niederwald to Lockhart- Sta. 14.

TROCHAMMINA TEXANA Cushman and Waters

Pl. 3, fig. 1 a, b, c

(Plesiotype- Univ. of Texas Geol. Coll. 13)

Trochammina texana Cushman and Waters, 1927, Contrib. Cushman Lab. Foram. Res., Vol. II, Part IV, p. 85, pl. II, figs. 8 a-c.

Test trochoid, compressed, dorsal side flattened, ventral side convex and umbilicate, periphery subacute, faintly lobulated; chambers indistinct in the early portion, more distinct later, 6 in the last formed coil, borders thickened, centers

depressed dorsally, thickest near the umbilicus on the ventral side; sutures raised slightly, curved dorsally, depressed, radial, and straight ventrally; wall finely arenaceous; smooth.

Diameter 0.55 mm.

There is a superficial resemblance to Haplophragmoides excavata Cushman and Waters, also present in the arenaceous phase of the same formation, but this species is distinctly trochoid.

Trochammina texana is typical of the sandy upper beds of the Webberville. It has not, as yet, been observed elsewhere.

Locality: Travis County, Union Creek, near Del Valle- 85 feet above the water's edge.

Family LAGENIDAE

Genus LENTICULINA Cushman, 1927

LENTICULINA ROTULATA (Lamarck)

Pl. 3, fig.2

(Plesiotype- Univ. of Texas Geol. Coll. 14)

Lenticulites rotulata Lamarck, 1804, Ann. Mus., Vol. VIII, pl. 62, fig. II.
Cristellaria rotulata d'Orbigny, 1840, Mem. Soc. Geol. France, Ser. I, Vol. IV, p. 26, pl. 2, figs. 16-18.
Cristellaria rotulata Parker and Jones, 1865, Phil. Trans., Vol. CLV, p. 345, pl. 13, fig. 19.
Cristellaria rotulata H. B. Brady, 1884, Challenger, Vol. IX, (Zool.), p. 547, pl. 69, figs. 13 a, b.
Cristellaria rotulata Burrows, Sherborn, and Bailey, 1890, Jour. Roy. Mic. Soc., p. 559, pl. 10, fig. 17.
Cristellaria rotulata Flint, 1899, Ann. Rpt. Nat. Mus., for 1897, p. 314, pl. 64, fig. 4.
Cristellaria rotulata Bagg, 1901, Maryland Geol. Survey, Eocene, p. 242, pl. 63, fig. 5.
Cristellaria rotulata Id., 1912, U. S. Geol. Survey Bull. 513, p. 67, pl. 19, fig. 5.
Cristellaria rotulata Cushman, 1913, U. S. Nat. Mus. Bull. 71, Part III, p. 66, pl. 35, fig. 3.

Cristellaria rotulata Id., 1918, U. S. Nat. Mus. Bull. 103, p. 60, pl. 22, fig. I.
Cristellaria rotulata Id., 1921, U. S. Geol. Survey Prof. Paper 129, p. 130, pl. 32, fig. I.
Cristellaria rotulata Id., 1921, U. S. Nat. Mus. Bull. 100, Vol. IV, p. 223.
Cristellaria rotulata Id., 1923, U. S. Nat. Mus. Bull. 104, Part IV, p. 108, pl. 22, fig. 2.
Lenticulites rotulata Id., 1927, Contrib. Cushman Lab. Foram. Res., Vol. III, Part II, p. 124, 125.
Lenticulina rotulata Id., 1927, Contrib. Cushman Lab. Foram. Res., Vol. III, Part III, p. 142.

Test subcircular in outline, planospiral, biconvex, periphery subcarinate but not keeled; chambers 8 to 9 in the final convolution; sutures distinct, slightly raised, curving acutely from the large central boss, terminating on the periphery in a small, clear triangle marking previous apertures; apertural face triangular; aperture radiate.

Diameter 1- 1.2 mm.

L. rotulata occurs rarely in the Webberville. It is rather abundant in the upper Midway and in the Taylor.

Locality: Caldwell County, on the road from Niederwald to Lockhart- Sta. 2.

LENTICULINA GIBBA (d'Orbigny)

Pl. 3, fig. 3

(Plesiotype- Univ. of Texas Geol. Coll. 15)

Cristellaria gibba d'Orbigny, 1826, Ann. Sci. Nat., Vol. VII, p. 292, Modele No. 17.
Cristellaria gibba Id., 1839, Foram, Cuba, p. 63, pl. 7, figs. 20, 21.
Cristellaria gibba H. B. Brady, 1884, Challenger, Vol. IX, (Zool.), p. 546, pl. 69, figs. 8, 9.

Cristellaria gibba Burrows, Sherborn, and Bailey, 1890, Jour. Roy. Mic. Soc., p. 559, pl. 10, figs. 19 a, b.
Cristellaria gibba Chapman, 1896, Jour. Roy. Mic. Soc., p. 4, pl. 1, fig. 7.
Cristellaria gibba Burrows and Holland, 1897, Proc. Geol. Assoc., Vol. XV, p. 44, pl. 2, figs. 5, 6.
Cristellaria gibba Flint, 1899, Ann. Rpt. U. S. Nat. Mus., for 1897, p. 317, pl. 64, fig. I.
Cristellaria gibba Bagg, 1901, Maryland Geol. Survey, Eocene, p. 241, pl. 63, fig. 4.
Cristellaria gibba Earland, 1905, Jour. Quekett Mic. Club, Ser. 12, Vol. IX, No. 57, p. 216.
Cristellaria gibba Bagg, 1912, U. S. Geol. Survey Bull. 513, p. 66, pl. 19, fig. 4.
Cristellaria gibba Cushman, 1913, U. S. Nat. Mus., Bull. 71, Part 3, p. 69, pl. 35, fig. I.
Cristellaria gibba Cushman, 1918, U. S. Geol. Survey Bull. 676, p. 10, pl. 2, fig. 6.
Cristellaria gibba Id., 1919, U. S. Nat. Mus., Bull. 100, Vol. IV, p. 228, pl. 45, fig. I.
Cristellaria gibba Id., 1923, U. S. Nat. Mus., Bull. 104, Part IV, p. 105, pl. 25, fig. 4.

Test close coiled, planospiral, biconvex, completely involute, slightly compressed, somewhat triangular in outline, periphery subcarnate, angular; chambers narrow, 7 to 9 visible; sutures gently curved, raised and thickened near the center where a node is sometimes present, tapering and less raised toward the periphery where they expand in a clear triangle which marks previous apertures; wall smooth; apertural face convex, triangular; aperture radiate, slightly protruding, located at the extremity of the septal face.

Diameter up to 0.85 mm.

L. gibba is moderately common throughout the Webberville. It occurs also in the Midway, Taylor, and Austin formation.

Locality: Travis County, Onion Creek, near Del Valle, 75 feet above the water's edge.

CRISTELLARIA SCITULA Berthelin

Pl. 3, fig. 4

(Plesiotype- Univ. of Texas Geol. Coll. 16)

Cristellaria scitula Berthelin, 1880, Mem. Soc. Geol. France, Ser. III, Vol. I, p. 54, pl. 3, fig. 3.

Test elongate, flattened, initial end broadly rounded, apertural end pointed, periphery acute; early chambers coiled, followed by 4 to 5 chambers in oblique series; sutures curved, later ones often slightly elevated in the center on either side and not always extending to the umbilicus, but terminating on the periphery; wall smooth; aperture terminal, radiate, protruding, located at the upper angle of the ultimate chamber.

Length up to 0.60 mm.

C. scitula may be distinguished from the very similar species, C. crepidula, by its possession of fewer and wider chambers than the latter.

This species is found rarely throughout the Webberville to its base. It also characterizes upper Midway faunule so it is of no diagnostic importance.

Locality: Hays and Caldwell Counties, on the road from Niederwald to Lockhart- Basal Webberville.

CRISTELLARIA TEXANA n. sp.

Pl. 4, fig. 3

(Holotype- Univ. of Texas Geol. Coll. 17)

Test elongate, early portion coiled, somewhat compressed,

later portion more or less erect, inflated, subtriangular in cross section, dorsal periphery convex, subacute, ventral periphery concave, broad, angles rounded; chambers distinct, low, broad, final chamber slightly more inflated than the others; sutures oblique, flush in the initial portion but often slightly depressed between the later chambers, terminating on the dorsal periphery in clear triangles marking previous apertures; wall smooth; apertural face subtriangular, slightly convex; aperture eccentric, radiate, protruding.

Length up to 0.75 mm.

C. texana cannot be of the genus Saracenaria, although it somewhat resembles S. italica, because of its lack of the proximal radiate slit in addition to the radiate aperture characteristic of that genus. This species very closely resembles C. beali Cushman, found in the Miocene Monterey shales of California, except for the absence of the angle in the sutures near the periphery. C. texana is a larger, stouter species than C. arcuata.

C. texana is found in the lower Webberville and, so far as now known, does not occur elsewhere in the Texas section.

Locality: Hays and Caldwell Counties, on the road from Niederwald to Lockhart- Basal Webberville.

CRISTELLARIA CREPIDULA Fichtel and Moll

Pl. 4, fig. 4

(Plesiotype- Univ. of Texas Geol. Coll. 18)

Natuilus crepidula Fichtel and Moll, 1803, Test. Micr., p. 107, pl. 19, figs. g- i.
Cristellaria crepidula d'Orbigny, 1839, Foram. Cuba, p. 64, pl. 8, figs. 17, 18.
Cristellaria berthelotiana Id., 1839, Foram. Canaries, p. 125, pl. I, figs. 14, 15.
Cristellaria intermedia Reuss, 1845, Verstein. Bohm. Kreid., Part I, pp. 33, 108, pl. 13, figs. 57, 58; Part II, pl. 24, figs. 50, 51.
Cristellaria cymboides d'Orbigny, 1846, For. Foss. Vien., p. 85, pl. 3, figs. 30, 51.
Cristellaria intermedia Alth., 1850, Haidinger's Naturw. Abhandl., Vol. III, p. 267, pl. 13, fig. 23.
Cristellaria jugleri Reuss, 1851, Zeit. d. deutsch. geol. Gesell., Vol. III, p. 89, pl. 4, fig. 19 a, b.
Cristellaria subarcuatula Williamson, 1858, Rec. For. Gt. Brit., p. 29, pl. 2, figs. 56, 57.
Cristellaria grata Reuss, 1862, Sitz. k. Akad. Wiss. Wien, Vol. XLVI, p. 70, pl. 7, fig. 14.
Cristellaria planiscula Id., Ibid., p. 71, pl. 7, fig. 15.
Cristellaria cordiformis Terquem, 1863, Foram. du Lias, troiseme mem., p. 203, pl. 9, fig. 14 a, b.
Cristellaria acuminata Id., Ibid., p. 210, pl. 10, fig. 5 a, b.
Hemirobulina compressa, 1864, Novara-Exped., geol. Theil, Vol. I, Palaont., p. 229, pl. 23, figs. 8 a, b.
Cristellaria crepidula Parker and Jones, 1865, Phil. Trans., Vol. CLV, p. 344, pl. 13, figs. 15, 16.
Cristellaria kochi Reuss, 1866, Denkschr. d. k. Akad. Wiss. Wien, Vol. XXV, p. 139, pl. 2, figs. 35 a, b.
Cristellaria galeata Id., Ibid., p. 141, pl. 3, fig. 8 a, b.

Test elongate, arcuate, flattened, periphery sharp, thin but noncarinate; initial chambers close coiled, later ones in oblique series and slightly inflated, distinct; sutures oblique, curved, flush in early portion, depressed in later portion, terminating on the dorsal periphery in clear triangles marking previous apertures; wall smooth; aperture radiate, protruding,

located at the extremity of the final chamber.

Length 1.5 mm.; width 0.40 mm.

This species is very like C. albatrossi Cushman. The latter, however, has a thin, broad keel on the early portion of the test. Marginulina lituus d'Orbigny appears to be very similar also, but Cushman believes it is the same as C. albatrossi Cushman.

Only one specimen of C. crepidula was found so nothing can be said of its stratigraphic importance. It has not been reported from any other Cretaceous formation in Texas.

Locality: Travis County, Onion Creek, near Del Valle- 15 feet above water's edge.

CRISTELLARIA SUBCARINATA n. sp.

Pl. 4, fig. 5

(Holotype- Univ. of Texas Geol. Coll. 19)

Test small, periphery sharply angular; chambers in the initial portion coiled and somewhat compressed, those in the latter portion exhibiting a decided tendency to uncoil, inflated, subovate in transverse section; sutures distinct, curved, slightly depressed, all extending practically to the umbilicus and ending on the dorsal periphery in a small, clear triangle marking previous apertures; apertural face subtriangular, slightly convex; aperture radiate, protruding, at the extremity of the final chamber.

Length 0.25- 0.30 mm; breadth 0.15 mm.

Only one specimen was found so nothing can be said of the stratigraphic importance of this species.

Locality: Hays and Caldwell Counties, on the road from Niederwald to Lockhart- Basal Webberville.

CRISTELLARIA NAVARROENSIS Plummer

Pl. 3, fig. 5

(Plesiotype- Univ. of Texas Geol. Coll. 20)

Cristellaria navarroensis Plummer, 1926, Univ. of Texas Bull. 2644, pp. 39, 40, and 97, text figure 4 a, b.

Test large, circular, close coiled, somewhat compressed, periphery broadly flanged; chambers 10 to 12, radiating from a large, clear, central boss; sutures elevated, curved, tapering toward the periphery; aperture radiate, at the apex of the apertural face.

Diameter up to 1.5 mm.

This species is very much like C. midwayensis (Plummer) var. carinata Plummer. The flange of the latter is usually thinner and less entire; coarser sutures extend from a larger umbonal boss; and the test is persistently more inflated in this species than in C. navarroensis.

C. navarroensis is frequently one of the most common of the micro-organisms to be found in the upper Webberville faunule.

Locality: Travis County, Onion Creek, near Del Valle- 40 feet above the water's edge.

Genus MARGINULINA d'Orbigny, 1826

MARGINULINA COSTATA (Batsch)

Pl. 5, fig. 1 a,b

(Plesiotype- Univ. of Texas Geol. Coll. 21)

Nautilus (Orthoceras) costatus Batsch, 1791, Conch. des Seesandes, p. 2, pl. I, fig. I.
Marginulina raphanus d'Orbigny, 1826, Ann. Sci. Nat., Vol. VII, p. 258, No. I, pl. 10, figs. 7, 8.
Marginulina obliquestriata Karrer, 1861, Sitz. k. Akad. Wiss. Wien, Vol. XLIV, p. 446, pl. I, fig. 8.
Marginulina striatocostata Reuss, 1862, Sitz. k. Akad. Wiss. Wien, Vol. XLVI, p. 62, pl. 6, fig. 2.
Marginulina turgida Id., 1862, Ibid., p. 63, pl. 6, fig. 7.
Marginulina raphanus Parker, Jones, and Brady, 1865, Ann. Mag. Nat. Hist., Ser. III, Vol. XVI, p. 19, pl. I, fig. 35.
Marginulina costata H. B. Brady, 1884, Challenger, Vol. IX, (Zool.), p. 258, pl. 65, figs. 10-13.
Marginulina costata Sherborn and Chapman, 1889, Jour. Roy. Mic. Soc., p. 487, pl. II, fig. 28.
Marginulina costata Jones, Parker, and Brady, 1896, Crag. Monog., Palaeont. Soc., p. 235, pl. I, fig. 21.
Marginulina costata Bagg, 1912, U. S. Geol. Survey Bull. 513, p. 62, pl. 18, fig. 4.
Marginulina costata Cushman, 1919, U. S. Nat. Mus. Bull. 100, Vol. IV, p. 256, pl. 41, figs. 5-8.

Test elongate, tapering apiculate, subcylindrical in transverse section; chambers about as broad as high, oblique, final chambers slightly inflated; sutures faintly depressed between early chambers, more apparent in older portion; wall ornamented by numerous, fine, sharp, longitudinal costae extending from the apertural margin obliquely downward and toward the other side; aperture eccentric, protruding, radiate, round.

Length up to 1.5 mm.

This species occurs but rarely in the Webberville. It is found very sparingly in the upper faunal unit of the Midway.

Locality: Hays County, on the road from Niederwald to Lockhart- Sta. 2.

MARGINULINA REGULARIS d'Orbigny

Pl. 5, fig. 2

(Plesiotype- Univ. of Texas Geol. Coll. 22)

Marginulina regularis d'Orbigny, 1846, Foram. Foss. Vien., p. 68, pl. 3, figs. 9-12.
Vaginulina glabra Goes, 1894, K. Svensk. Vet. Akad. Handl., Vol. XX, No. 9, p. 65, pl. II, figs. 656-658.

Test elongate, subcylindrical in cross section, tapering toward the attenuate, faintly coiled initial end; chambers few, increasing in size with age, broader than high except for the final chamber which is longer than broad; sutures oblique, constricted, distinct after the second chamber; aperture eccentric, protruding, radiate.

Length up to 0.75 mm.

This species is found in the upper Midway and very rarely in the Webberville.

Locality: Travis County, Onion Creek, near Del Valle- 25 feet above the water's edge.

MARGINULINA WHITNEYI n. sp.

Pl. 8, fig. 1

(Holotype- Univ. of Texas Geol. Coll. 23)

Test elongate, arcuate, stout, about the same breadth throughout; early chambers coiled, later ones uncoiled, full, oblique, gradually increasing in height; sutures distinct, de-

pressed in later portion; wall smooth; aperture terminal, eccentric, radiate.

Length 1.45- 1.50 mm.; breadth 0.30 mm.

Too few specimens were found to make a statement concerning the stratigraphic importance of this species.

Locality: Travis County, Onion Creek, near Del Valle- 20 feet above the water's edge.

Genus NODOSARIA Lamarck, 1812

NODOSARIA GRANTI Plummer

Pl. 5, fig. 3

(Plesiotype- Univ. of Texas Geol. Coll. 24)

Nodosaria granti Plummer, 1926, Univ. of Texas Bull. 2644, p. 83, pl. 5, figs. 9 a, b.

Test elongate, slender, arcuate, apiculate; chambers numerous, varying from ones of equal breadth and height to others three times as long as broad, subcylindrical to slightly inflated; sutures straight, unconstricted to gently constricted; smooth; aperture round, radiate.

Length probably up to several millimeters.

From N. consobrina d'Orbigny var. emaciata Reuss this species may be distinguished by its greater length of chambers and from N. filiformis d'Orbigny by its transverse sutures.

N. granti occurs sparingly throughout the Webberville and in the Taylor. It is found widely distributed in the Midway clays but is more abundant in the basal portion.

Locality: Hays County, on the road from Niederwald to Lockhart- Sta. 1.

NODOSARIA SPINESCENS (Reuss)

Pl. 5, fig. 4

(Plesiotype- Univ. of Texas Geol. Coll. 25)

Dentalina spinescens Reuss, 1851, Zeit. deutsch. geol. Gesell., Vol. III, p. 62, pl. 3, fig. 10.
Nodosaria spinescens Plummer, 1926, Univ. of Texas Bull. 2644, p. 84, pl. 4, fig. 12.

Test elongate, slender, tapered toward the apical portion, slightly arcuate; chambers slightly inflated, ellipsoid to pyriform, increasing in length with age; sutures moderately constricted; chambers ornamented at the base by a row of down-hanging spines; aperture, large, round, phialine.

Length unknown.

In the Webberville this species occurs very sparingly in the upper portion. It is found rarely in the upper Midway.

Locality: Hays County, on the road from Niederwald to Lockhart- Sta. 1.

NODOSARIA SOLUTA (Reuss)

Pl. 5, fig. 5

(Plesiotype- Univ. of Texas Geol. Coll. 26)

Dentalina soluta Reuss, 1851, Zeit, deutsch. geol. Gesell., Vol. III, p. 60, pl. 3, fig. 4.
Nodosaria soluta Bornemann, 1855, Zeit. deutsch. geol. Gesell., Vol. VII, p. 322, pl. 12, fig. 12.
Dentalina soluta Hantken, 1875, Mitth. Jahrb. k. ungar. geol. Anstalt, Vol. IV, p. 29, pl. 3, fig. 2.

Nodosaria soluta Sherborn and Chapman, 1886, Jour. Roy. Mic. Soc., p. 746, pl. 14, fig. 25.
Nodosaria soluta Chapman, 1900, Proc. Calif. Acad., Ser. III, Vol. I, No. 8, p. 248, pl. 29, fig. 14.
Nodosaria soluta Bagg, 1912, U. S. Geol. Survey Bull. 513, p. 59, pl. 15, fig. 2; pl. 16, fig. 7.

Test elongata, slightly arcuate, apiculate; chambers comparatively few, subglobular and inflated except for the broadly ovate final chamber; sutures straight, deeply constricted, often most apparent between the last two chambers; wall smooth; aperture terminal, round, radiate, slightly protruding.

Length up to 0.70 mm.

N. soluta differs from N. subsoluta Cushman in its smoothness of test.

In the Webberville this species is found very rarely. It is found occasionally in the overlying Midway and in the underlying Taylor.

Locality: Travis County, Onion Creek, near Del Valle- 5 feet above the water's edge.

NODOSARIA MUCRONATA (Neugeboren)

Pl. 6, fig. 1

(Plesiotype- Univ. of Texas Geol. Coll. 27)

Dentalina mucronata Neugeboren, 1856, Denk. k. Akad. Wiss. Wien, Vol. XII, p. 83, pl. 3, figs. 8-11.
Nodosaria mucronata H. B. Brady, 1884, Challenger, Vol. IX, (Zool.), p. 506, pl. 62, figs. 27-21.
Nodosaria mucronata H. B. Brady, Parker, and Jones, 1888, Trans. Zool. Soc. London, Vol. XII, p. 223, pl. 44, fig. 10.
Nodosaria mucronata Chapman, 1893, Jour. Roy. Mic. Soc., p. 590, pl. 9, fig. 2.

Nodosaria mucronata Flint, 1899, Ann. Rpt. U. S. Nat. Mus., for 1897, p. 311, pl. 57, fig. 2.
Nodosaria mucronata Cushman, 1913, U. S. Nat. Mus. Bull. 71, Part III, p. 56, pl. 24, fig. 3; pl. 25, fig. 2; pl. 27, figs. 5-7; pl. 35, fig. 6.
Nodosaria mucronata Id., 1923, U. S. Nat. Mus. Bull. 104, Part. IV, p. 80, pl. 13, figs. 5-7; pl. 13, figs. 7- 9.

Test elongate, tapering, oral end rounded, aboral end acute, mucronate; chambers about as broad as high except for the final one which is large, about twice as high as broad, inflated; sutures faint in early portion, flush, depressed in later portion, oblique; aperture terminal, eccentric, protruding, radiate.

Length up to 0.70 mm.

From N. communis d!Orbigny this species is distinguished by its sharply pointed aboral end.

N. mucronata is fairly common in the Webberville. It occurs rarely in the Midway.

Locality: Hays County, on the road from Niederwald to Lockhart- Basal Webberville.

NODOSARIA AFFINIS d'Orbigny

Pl. 6, fig. 2

(Plesiotype- Univ. of Texas Geol. Coll. 28)

Nodosaria affinis d'Orbigny, 1846, Foram. Foss. Vienne, p. 39, pl. I, figs. 36- 39.
Nodosaria affinis Sherborn and Chapman, 1886, Jour. Roy. Mic. Soc., p. 748, pl. 14, fig. 33.
Nodosaria affinis Bagg, 1901, Maryland Geol. Survey, Eocene, p. 236, pl. 62, fig. 5.

Test straight, elongate, apiculate; chambers subglobular,

approximately equal in size; sutures transverse, constricted; test ornamented by 9 to 11 strong, sharp, longitudinal costae some of which are discontinuous, extending from the apical end to the aperture; aperture terminal, round, protruding, mamillate.

Length unknown.

This species is rare in the Webberville and in the Taylor. It is rather common in the Midway.

Locality: Hays County, on the road from Niederwald to Lockhart- Sta. 1.

NODOSARIA VERTEBRALIS (Batsch) var. WEBBERVILLENSIS n. var.

Pl. 8, fig. 2

(Holotype- Univ. of Texas Geol. Coll. 29)

Test elongate, straight or slightly arcuate, tapering somewhat toward the apical extremity which is terminated by a short, stout spine; chambers full but not inflated, gradually increasing in size with age, initial chamber bulous; sutures are dark bands constituting faint areas of constriction; test ornamented by 8 to 9 sharp, coarse costae extending from the apical end across the final chamber, where they terminate abruptly, forming a shoulder-like prominence; aperture terminal, central, round, much produced.

Length up to 1.6 mm.

This species is exceedingly rare in the Webberville. The specimen figured is the basal portion of the formation.

Locality: Hays County, on the road from Niederwald to Lockhart- Basal Webberville.

NODOSARIA POMULIGERA (Stache)

Pl. 6, fig. 3

(Plesiotype- Univ. of Texas Geol. Coll. 30)

Dentalina pomuligera Stache, 1864, Novara-Exped., Vol. 1. p. 204, pl. 22, fig. 31.
Nodosaria pomuligera Plummer, 1926, Univ. of Texas Bull. 2644, p. 81, pl. 4, figs. 15 a, b.

Test elongate, arcuate, tapering toward the rounded initial end; chambers numerous, close-set, broader than high in the early portion, becoming about equal in proportions with maturity; sutures transverse, marked by dark lines, constricted, more apparent in the later portion where they are often partially filled with an overlap of shell material; wall smooth, aperture eccentric, radiate, protruding.

Length about 2.50- 3 mm.

N. pomuligera occurs rarely in both the Webberville and the Taylor and it is fairly common in the Midway.

Locality: Travis County, Onion Creek, near Del Valle- 40 feet above the water's edge.

NODOSARIA RADICULA (Linnaeus)

Pl. 6, fig. 4

(Plesiotype- Univ. of Texas Geol. Coll. 31)

Nautilus radicula Linnaeus, 1767, Syst. Nat., 12th. ed., p. 285, 1164; Gmelin's ed. 13, 1788, Vol. I, Part VI, p. 3373, No. 18.

Nodosaria radicula radicula d'Orbigny, 1826, Ann. Sci. Nat., Vol. VII, p. 252, No. 3, Modele No. 1.
Nodosaria beyrichi Neugeboran, 1856, Denk. k. Akad. Wiss. Wien, Vol. XII, p. 72, pl. 1, figs. 7- 9.
Nodosaria radicula Jones and Parker, 1860, Quart. Jour. Geol. Soc., Vol. XVI, pl. 19, figs. 4, 5.
Nodosaria radicula Parker and Jones, 1865, Phil. Trans. Vol. CLV, p. 341, pl. 13, figs. 2- 7.
Nodosaria beyrichi Hantken, 1874, Mitth. Jahr. k. ungar. geol. Anstalt, Vol. IV, p. 23, pl. 2, fig. 5.
Nodosaria radicula H. B. Brady, 1884, Challenger, Vol. IX, (Zool.), p. 495, pl. 61, figs. 28- 31.
Nodosaria radicula Flint, 1899, Ann. Rpt. U. S. Nat. Mus., for 1897, p. 309, pl. 55, fig. I.
Nodosaria radicula Cushman, 1919, U. S. Nat. Mus. Bull. 100, Vol. IV, p. 190, pl. 34, fig. 4.
Nodosaria larva Carsey, 1926, Univ. of Texas Bull. 2612, p. 31, pl. 2, fig. 2.

Test elongate, only slightly tapering, variable in length according to the stage of growth, cylindrical, apical end bluntly pointed, apertural end rounded; chambers varying in number from 2 to 7, initial chambers indistinct, intermediate ones low and broad, final one larger than the others; septal lines transverse, increasingly constricted toward the oral end; wall smooth, porcellanous, glistening; qperture terminal, central slightly protruding, round, radiate.

Length up to 1 mm.

N. radicula is common to the Midway, Webberville, and Taylor. It is somewhat larger in the Midway than in the Cretaceous formations.

Locality: Travis County, Onion Creek, near Del Valle, 40 feet above the water's edge.

NODOSARIA ALTERNATA Carsey

Pl. 6, fig. 5

(Plesiotype- Univ. of Texas Geol. Coll. 32)

Nodosaria alternata Carsey, 1926, Univ. of Texas Bull. 2612, p. 35, pl. 4, fig. 7.

Test elongate, very slightly tapered toward the initial end which is provided with one or two short spines; chambers indistinct, about as broad as high, initial one very slightly inflated; sutures faintly constricted; ornamented by two types of ribs, one sharp, thin, broken, running the length of the test, the other lower and found only on the chambers, not continuing across the sutures.

Length up to 1.65 mm.

This species is scarce in both the Webberville and the Taylor formations.

Locality: Travis County, Onion Creek, near Del Valle- 40 feet above the water's edge.

NODOSARIA FILIFORMIS d'Orbigny

Pl. 7, fig. 1

(Plesiotype- Univ. of Texas Geol. Coll. 33)

Nodosaria filiformis d'Orbigny, 1826, Ann. Sci. Nat., Vol. VII, p. 253, No. 14.
Nodosaria filiformis Cuvier, 1834, Animal Kingdom, Henderson's ed. 3, p. 18, pl. 8, fig. 10.
Nodosaria filiformis Terrigi, 1883, Atti. Acc. Pont. Nuovi. Lincei, Vol.XXXV, p. 174, pl. 2, fig. 8.
Nodosaria filiformis Brady, 1884, Challenger, p. 500, pl. 63, figs. 3- 5.

Test elongate, arcuate, tapered; chambers broader than high in the early stages but becoming longer than broad in the older portion, later chambers slightly inflated; sutures oblique, constricted except in the very early portion; wall smooth; aperture eccentric, radiate, protruding.

Length 1.5 to 2 mm.

N. filiformis is scarce in the Webberville. It occurs sparingly in the Taylor and also in the Del Rio.

Locality: Travis County, Onion Creek, near Del Valle- 10 feet above the water's edge.

NODOSARIA COMMUNIS d'Orbigny

Pl. 7, fig. 2

(Plesiotype- Univ. of Texas Geol. Coll. 34)

Nodosaria (Dentalina) communis d'Orbigny, 1826, Ann. Sci. Nat., Vol. VII, p. 254, No. 35.
Dentalina communis Id., 1840, Mem. Soc. Geol. France, Vol. IV, p. 13, pl. I, fig. 4.
Nodosaria communis, Reuss, 1845, Verstein. Bohm. Kreid., Part I, p. 28, pl. 12, fig. 21.
Nodosaria legumen Id., Ibid., p. 28, pl. 13, figs. 23, 24.
Dentalina inornata d'Orbigny, 1846, For. Foss. Vien., p. 44, pl. I, figs. 50, 51.
Dentalina ferstlian Czjzek, 1848, Haidinger's Naturw. Abhandl., Vol. II, pp. 140, pl. 12, figs. 10- 13.
Dentalina haueri Neugeboren, 1856, Denk. k. Akad. Wiss. Wien, Vol. XII, p. 81, pl. 2, fig. 12.
Dentalina subarcuata Williamson, 1858, Rec. Foram. Gr. Brit., p. 18, pl. 2, figs. 40, 41.
Dentalina legumen Reuss, 1860, Sitz. k. Akad. Wiss. Wien, Vol. XI, p. 187, pl. 3, fig. 5.
Dentalina intermedia Id., Ibid., p. 186, pl. 2, fig. 8.
Dentalina communis Id., Ibid., p. 186.

Dentalina communis Parker and Jones, 1862, Introd. Foram., Appendix, p. 310.
Dentalina deflexa Reuss, 1862, Sitz. k. Akad. Wiss. Wien, Vol. XLVI, p. 43, pl. 2, fig. 19.
Dentalina inornata Reuss, 1863, Ibid., Vol. XLVIII, p. 45, pl. 2, fig. 18.
Nodosaria neugeboreni Schwager, 1866, Novara-Exped., geol. Theil, Vol. II, p. 232, pl. 6, fig. 67.
Dentalina badensis, Hantken, 1875, Mitth. Jahrb. k. ungar. geo. Anstalt, Vol. IV, p. 34, pl. 3, fig. 12.
Nodosaria communis Brady, 1884, Challenger, p. 504, pl. 62, figs. 19- 22.

Test elongate, arcuate, tapering toward the bluntly rounded initial end; chambers enlarging with age, increasingly inflated toward the oral end; sutures oblique, constricted; wall smooth; aperture eccentric, radiate, protruding.

Length about 1 mm.

N. communis is somewhat common in the Webberville. It is of little diagnostic importance, however, since it occurs rarely in the Taylor and in the Del Rio.

Locality: Travis County, Onion Creek, near Del Valle- 15 feet above the water's edge.

NODOSARIA PAUCISTRIATA n. sp.

Pl. 8, fig. 3

(Holotype- Univ. of Texas Geol. Coll. 35)

Test elongate, very slender; chambers long, not inflated; sutures indistinct, marked vaguely by dark lines; wall ornamented by 6 to 7 sharp, thin costae, sometimes discontinuous, slightly twisted longitudinally.

Length unknown.

This species is very rare in the Webberville. A similar, and probably identical, species occurs more abundantly in the Taylor.

Locality: Travis County, Onion Creek, near Del Valle- 10 feet above the water's edge.

NODOSARIA ELONGALOCULATA n. sp.

Pl. 8, fig. 4

(Holotype- Univ. of Texas Geol. Coll. 36)

Test elongate; chambers slender, four or five times as long as broad, somewhat pyriform, very slightly inflated if at all; sutures narrow, deeply constricted; wall ornamented by numerous, short, sharp, downhanging spines.

Length unknown. Length of two chambers 0.75 mm.

This species is scarce in the upper Webberville. Due to its apparent length and the small diameter of the test at the sutures it is easily broken. It is usually found in two-chambered fragments. It is not found in the Taylor.

Locality: Travis County, Onion Creek, near Del Valle- 35 feet above the water's edge.

NODOSARIA SCALARIFORMIS n. sp.

Pl., fig.

(Holotype- Univ. of Texas Geol. Coll. 37)

Test elongate, apiculate, composed of few chambers, the initial chamber somewhat bulbulous; sutures distinct, constricted,

marked by a rather broad, clear band; ornamented by 8 low, narrow, sharp costae extending from the apical extremity up to and onto the apertural neck; aperture terminal, protruding, radiate.

Length up to 0.75 mm.

Two or three specimens of this species were encourtered in the basal Webberville.

Locality: Hays County, on the road from Niederwald to Lockhart- Basal Webberville.

NODOSARIA PYRULA d'Orbigny var. SEMIRUGOSA d'Orbigny

Pl. 7, fig. 3

(Plesiotype- Univ. of Texas Geol. Coll. 38)

Nodosaria semirugosa d'Orbigny, 1846, Foram. Foss. Bass. Tert. Vienne, p. 34, pl. 1, figs. 20- 23.
Nodosaria stipitata Reuss, var. costulata Reuss, 1870, Sitz. Akad. Wiss. Wien, Vol. LXII, Abth. 1, p. 471.
Nodosaria costulata H. B. Brady, 1884, Challenger, Vol. IX, p. 515, pl. 63, figs. 23- 27.
Nodosaria costulata Flint, 1899, Ann. Rpt. U. S. Nat. Mus., for 1897, p. 312, pl. 58, fig. I.
Nodosaria pyrula d'Orbigny, var. semirugosa d'Orbigny, 1913, U. S. Nat. Mus. Bull. 71, Part III, p. 50, pl. 26, figs. 4- 8.

Test elongate; chambers subovate, inflated, sutures relatively broad areas of deep constriction forming a short, slender neck; wall covered with longitudinal striae the disposition of which may be straight slightly twisted, often more distinct on the intervening segments than on the chambers where they sometimes tend to disappear; aperture protruding, radiate.

Length unknown.

This variety of N. pyrula is found sparingly in the Webberville.

Locality: Travis County, Union Creek, near Del Valle- 50 feet above the water's edge.

NODOSARIA SPINULOSA (Montagu)

Pl. 7, fig. 4

(Plesiotype- Univ. of Texas Geol. Coll. 39)

Nautilus spinulosa Montagu, 1808, Test. Brit. Supp., p. 86, pl. 19, fig. 5.
Dentalina spinulosa Sherborn and Chapman, 1886, Jour. Roy. Mic. Soc., p. 751, pl. 15, fig. 13.
Nodosaria spinulosa Bagg, 1898, U. S. Geol. Survey Bull. 88, p. 44.

Test elongate, arcuate, slightly tapered, apiculate; chambers numerous, longer than broad, gently inflated; sutures straight, depressed; wall ornamented by stout, downhanging spines which cover the whole chamber in the mature portion of the test.

Length probably up to several millimeters.

In the basal Midway clays this species is abundant, but it occurs only occasionally in the Webberville.

Locality: Cuttings from a well- 800-812 feet.

NODOSARIA SUBVERRUCULOSA n. sp.

Pl. 10, fig. 1

(Holotype- Univ. of Texas Geol. Coll. 40)

Test elongate, slightly arcuate, tapered gradually toward the rounded initial end; chambers subglobular, slightly inflated, about as long as broad, increasing in size with age; sutures constricted, filled with clear shell material; wall covered by numerous, very short, blunt spines; aperture relatively large,

terminal, radiate.

Length unknown.

This species is not common in the Webberville. The specimen figured came from the lower part of the formation.

Locality: Hays County, on the road from Niederwald to Lockhart- Sta. 2.

NODOSARIA RAPHANUS (Linne) var. FRAGILIS n. var.

Pl. 10, fig. 2

(Holotype- Univ. of Texas Geol. Coll. 41)

Test elongate, circular in cross section, aboral end apiculate and broadly rounded, oral end gently tapered; chambers few, subglobular, not inflated except for the final one; sutures straight, indistinct to slightly depressed; wall ornamented by 6 to 7 low, sharp, longitudinal ribs; aperture central, terminal, radiate, protruding.

Length up to 1 mm.

This variety of N. raphanus is rare in the Webberville.

Locality: Hays County, on the road from Niederwald to Lockhart- Sta. 1.

NODOSARIA OBLIQUA (Linnaeus)

Pl. 7, fig. 5

(Plesiotype- Univ. of Texas Geol. Coll. 42)

Nautilus obliquus Linnaeus, 1767, Syst. Nat., 12th ed., p. 281, 1163.
Nautilus obliquus (Gmelin's) ed., Id., 1788, Ibid., 13th p. 3372, No. 14.
Dentalina obliqua Jones, Parker, and Brady, 1866, Foram. Crag. Pal. Soc., Vol. XIX, p. 54, pl. 1, fig. 9.

Nodosaria obliqua Brady, 1884, Challenger, Vol. IX, (Zool.) p. 513, 514, pl. 64, figs. 20- 22.
Nodosaria obliqua Bagg, 1898, U. S. Geol. Survey Bull. 88, p. 41.
Nodosaria obliqua Id., 1898, Bull. American Paleont., Vol. II, No. 10, p. 320.
Nodosaria obliqua Chapman, 1900, Proc. Calif. Acad. Sci., Ser. III, Vol. I, No. 8, p. 249, pl. 29, fig. 17.
Nodosaria obliqua Cushman, 1913, U. S. Nat. Mus. Bull. 71, p. 59, pl. 25, fig. 5.

Test varies in size, elongate, linear, tapered somewhat toward the aboral end, straight or slightly arcuate, apiculate; chambers not much inflated, usually a little longer than broad, initial chamber larger than the one following; sutures straight, faintly constricted in the early portion, more apparent later; surface ornamented by numerous, low, sharp, longitudinal costae increasing in number as the oral end is approached, early ones spirally twisted, reaching to or onto the terminal spine, later ones often straight, continuous across chambers to the aperture; aperture terminal with a slight neck, slightly eccentric, radiate.

Length up to 1.75 mm.

N. obliqua is rare in the upper Webberville and in the Del Rio.

Locality: Travis Coounty, Onion Creek, near Del Valle- 20 feet above the water's edge.

Genus GLANDULINA d'Orbigny, 1826

GLANDULINA LAEVIGATA d'Orbigny

Pl. 9, fig. 1

(Plesiotype- Univ. of Texas Geol. Coll. 43)

Nodosaria (Gl.) laevigata d'Orbigny, 1826, Ann. Sci. Nat., Vol. VII, p. 252, pl. 10, figs. 1- 3.

Glandulina laevigata Id., 1846, Foram. Foss. Vienne, p. 29, pl. 1, figs. 4, 5.
Glandulina ovula Id., Ibid., p. 29, pl. 1, figs. 6, 7.
Glandulina pygmaea Reuss, 1850, Haidinger's Naturw. Abhandl., Vol. IV, p. 22, pl. 2, fig. 3.
Glandulina inflata Bornemann, 1855, Zeit. deutsch. geol. Gesell., Vol. VII, p. 320, pl. 12, figs. 6, 7.
Glandulina laevigata Id., Ibid., p. 320, pl. 12, fig. 8.
Glandulina elongata Id., Ibid., p. 321, pl. 12, fig. 9.
Glandulina acuminata Costa, 1856, Atti dell' Accad. Pontan., Vol. VII, p. 125, pl. II, fig. 19.
Glandulina inflata Id., Ibid., p. 126, pl. II, fig. 21.
Glandulina apiculata Id., Ibid., p. 127, pl. II, fig. 22.
Glandulina pyrula Id., Ibid., p. 370, pl. 27, fig. 26.
Glandulina abbreviata Neugeboren, 1856, Denk. k. Akad. Wiss. Wien, Vol. XII, p. 68, pl. I, fig. 1.
Glandulina laevigata Id., Ibid., p. 67, pl. I, figs. 3, 4.
Glandulina elliptica Reuss, 1863, Sitz. k. Akad. Wiss. Wien, Vol. XLVIII, p. 47, pl. 3, figs. 29- 31.
Glandulina globulus Id., Ibid., p. 66, pl. 8, figs. 94, 95.
Glandulina laevigata Parker and Jones, 1865, Phil. Trans., Vol. CLV, p. 340, pl. 13, fig. 1.
Nodosaria laevigata Brady, 1884, Challenger, Vol. IX, (Zool.) p. 490, pl. 61, figs. 17- 22.
Glandulina laevigata Haeusler, 1887, Neues Jahrb. fur. Min., p. 189, pl. 5, fig. 29,
Nodosaria laevigata Burrows, Sherborn, and Bailey, 1890, Jour. Roy. Mic. Soc., p. 556, pl. 19, figs. 14, 15.
Glandulina laevigata Egger, 1893, Abh. kon. bay. Akad. Wiss. Munchen, Cl. II, Vol. XVIII, p. 336, 339, pl. II, fig. 31.
Nodosaria laevigata Flint, 1899, Ann. Rpt. U. S. Nat. Mus., for 1897, p. 308, pl. 55, fig. 3.
Glandulina laevigata Silvestri, 1900, Mem. Pont. Accad. Nuovi Lincei, Vol. XVII, p. 248, pl. 6, figs. 41, 49.
Nodosaria laevigata Bagg, 1908, Proc. U. S. Nat. Mus., Vol. XXXIV, p. 143.
Nodosaria laevigata Cushman, 1913, U. S. Nat. Mus. Bull. 71, Part III, p. 47, pl. 24, figs. 1, 2.
Glandulina laevigata Id., 1927, Contrib. Cushman Lab. Foram. Res., Vol. III, Part I, pl. 9, fig. 8.

Test pyriform, circular in transverse section, anterior end rounded or slightly tapered, posterior end acute, sometimes with

a spine; each chamber almost entirely enveloping the preceding one so that the last chamber, which occupies the greater part of the outside of the test, is the only one wholly visible; sutural lines in the apical portion, proximate, transverse; wall smooth, often glistening; aperture central, terminal, protruding, radiate.

Length up to 0.65 mm.

This species occurs sparingly in both the Webberville and the Taylor. A variety of the same species, G. laevigata var. occidentalis, is found rarely in the upper Midway.

Locality: Travis County, Onion Creek, near Del Valle- 10 feet above the water's edge.

Genus ROBULUS Montfort, 1808

ROBULUS CULTRATUS Montfort

Pl. 9, fig. 2

(Plesiotype- Univ. of Texas Geol. Coll. 44)

Robulus cultratus Montfort, 1808, Conchyl. System., Vol. 1, p. 214.
Robulina cultrata d'Orbigny, 1826, Ann. Sci. Nat., Vol. VII, p. 287, No. 1- Modele No. 82.
Robulina canariensis Id., 1839, Foram. Canaries, p. 127, pl. 3, figs. 3, 4.
Robulina subcultrata Id., 1839, Foram. Amer. Merid., p. 26, pl. 5, figs. 19, 20.
Robulina cultrata Id., 1846, Foram. Foss. Vien., p. 96, pl. 4, figs. 10- 12.
Robulina similis Id., Ibid., p. 98 pl. 4, figs. 14- 15.
Cristellaria hoffmanni Ehrenberg, 1854, Mikrogeologie, pl. 26, fig. 53.
Robulina limbosa Reuss, 1863, Sitz. k. Akad. Wiss. Wien, Vol. XLVIII, p. 55, pl. 6, fig. 69.
Cristellaria gyroscalprum Stache, 1864, Novara-Exped. geol. Theil, Vol. I, Palaont., p. 243, pl. 23, fig. 22 a, b.
Cristellaria cultrata Parker and Jones, 1865, Phil. Trans., Vol. CLV, p. 344, pl. 13, fig. 28.

Cristellaria cultrata Jones, Parker, and Brady, 1866, Crag. Foram. Pal. Soc., Vol. XIX, p. 1, fig. 24, 25.
Robulina curvispira Sequenza, 1879, Att. R. Accad. dei Lincei, Ser. III, Vol. VI, p. 144, pl. 13, fig. 28.
Cristellaria cultrata Jones, 1884, Quar. Jour. Geol. Soc., Vol. XL, p. 765, pl. 34, figs. 7, 10 and 11.
Cristellaria cultrata Brady, 1884, Challenger, p. 550, pl. 70, figs. 4- 8.
Cristellaria cultrata Sherborn and Chapman, 1886, Jour. Roy. Mic. Soc., Vol. VI, p. 754, pl. 15, figs. 28 a, b.
Cristellaria cultrata Flint, 1898, Ann. Rpt. Nat. Mus., for 1897, p. 318, pl. 65, fig. 2.
Cristellaria cultrata Bagg, 1908, Proc. U. S. Nat. Mus., Vol. XXXIV, p. 147.
Cristellaria cultrata Cushman, 1913, U. S. Nat. Mus. Bull. 71, Part III, p. 64, pl. 29, fig. 4.
Robulus cultratus Id., 1927, Contrib. Cushman Lab. Foram. Res., Vol. II, part I, pl. 9, fig. 1.

Test close coiled, planospiral, lenticular, completely involute, almost round in outline, bounded by a broad, sharp, thin keel which narrows in width and finally disappears entirely with the later chambers; chambers narrow, somewhat triangular, 8 to 13 visible; sutures smooth, gently curved, marked by thick, raised, tapering bands that become narrow lines almost flush with the surface toward the periphery where they expand in a clear triangle which marks previous apertures; wall smooth; apertural face convex, triangular; aperture an elongate slit on the apertural face in addition to the radiate aperture located at the extremity of the final chamber.

Diameter up to 1.7 mm.

This species is abundant in the Webberville and is considered characteristic of that formation. It occurs less frequently in the upper part of the Taylor marl.

From Lenticulina rotulata (Lamarck) R. cultratus may be dis-

tinguished by its less sweeping sutures, its broad, thin keel, and its aperture.

Locality: Hays County, on the road from Niederwald to Lockhart- Sta. 1.

ROBULUS RENIFORMIS (d'Orbigny)

Pl. 9, fig. 3

(Plesiotype- Univ. of Texas Geol. Coll. 45)

Cristellaria reniformis d'Orbigny, 1846, Foram. Foss. Vien., p. 88, pl. 3, fig. 39, 40.
Cristellaria reniformis Pictet, 1857, Traite de Paleont., ed. 2, Vol. IV, p. 495, pl. 109, fig. 13.
Cristellaria reniformis Brady, 1884, Challenger, p. 539, pl. 70, fig. 3 a, b.
Cristellaria reniformis Flint, 1899, Ann. Rpt. U. S. Nat. Mus., for 1897, p. 315, pl. 62, fig. 2.
Cristellaria reniformis Bagg, 1912, U. S. Geol. Survey Bull. 513, p. 66, pl. 19, figs. 2 a, b.
Cristellaria reniformis Cushman, 1913, U. S. Nat. Mus. Bull. 71, Part III, p. 65, pl. 30, fig. 4; pl. 33, fig. 1.
Robulus reniformis Hanna, G. D. and Church, 1927, Jour. of Paleont., Vol. I, No. III, p. 197.

Test planospiral, biconvex, strongly compressed, completely involute; initial chambers close coiled, later ones exhibiting a tendency to straighten out, triangular in outline, slightly to strongly keeled, the keel narrowing in width as the final chambers are approached; chambers comparatively few, 6 to 8 visible; sutures in the early portion of the test raised, thickened, curving away from a large, round, clear, central node, those sutures in the later portion straightening out and becoming flush with the surface or depressed, the last one often oblique, not reaching the center but terminating at the edge of the apertural face; the clear triangular enlargement in which the sutures termi-

nate marks previous apertures; wall smooth; apertural face long, narrow, straight; aperture an elongate slit in the convex apertural face in addition to the radiate aperture at the outher angle of the final chamber.

Greatest diameter up to 0.60 mm.

This species occurs sparingly in the Webberville, Taylor, and Austin.

Locality: Travis County, Onion Creek, near Del Valle- 25 feet above the river's edge.

Genus VAGINULINA d'Orbigny, 1826

VAGINULINA WEBBERVILLENSIS Carsey

Pl. 9, fig.4

(Plesiotype- Univ. of Texas Geol. Coll. 46)

Vaginulina webbervillensis Carsey, 1926, Univ. of Texas Bull. 2612, p. 39, pl. 2, fig. 7.

Test elongate, complanate, wing-shaped, broadest at about the center, tapering gradually toward the oral extremity and rapidly toward the aboral end; dorsal edge straight, ornamented by three or four low, sharp, longitudinal ridges; ventral side curved, primordial chamber swollen, ornamented by short, longitudinal costae which reach to, or onto, the terminal spine and most of which continue less than one-third the length of the test; chambers varying in number up to 20, long, narrow, increasing in length with age; sutures marked by clear, oblique lines flush with the surface; aperture terminal, protruding, round, radiate.

Length up to 5 or 6 mm., but more commonly 3 to 4 mm.

This form occurs abundantly throughout the Webberville formation to which it is confined. Its large size makes it easily recognizable in the field with the aid of a hand lens.

From V. simondsi Carsey this species may be distinguished by its greater size and by the presence of the swollen proloculum which is absent in the former.

Locality: Travis County, Onion Creek, near Del Valle- 40 feet above the water's edge.

VAGINULINA CUYLERI n. sp.

Pl. 10, fig. 3

(Holotype- Univ. of Texas Geol. Coll. 47)

Test elongate, slender, blade-like dorsal edge straight, ventral edge curved, oral and aboral extremities acutely pointed; chambers very long and narrow, increasing in length with age; sutures slightly raised, oblique; surface ornamented by very fine, short, delicate, discontinuous striae parallel to the direction of growth; aperture terminal, radiate.

Length up to 2 mm.

This species very closely resembles V. plumoides Plummer V. cuyleri, however, is larger; it has fewer chambers; and, the dorsal edge is perfectly straight while that of V. plumoides is slightly curved.

This species is found only in the Webberville and may be considered diagnostic of that formation.

Locality: Comal County, on the road from Niederwald to Lockhart-hart-Sta. 1.

VAGINULINA ORNATA n. sp.

Pl. 10, fig. 4

(Holotype- Univ. of Texas Geol. Coll. 48)

Test elongate, initial end rounded, circular in transverse section; chambers about as broad as high, approximately the same size except for the final chamber which is smaller; sutures depressed, straight; wall ornamented by very faint longitudinal striae except on the final chamber which is smooth; aperture terminal, with a neck, eccentric, radiate.

Length 0.75 mm.

Only one specimen was found so nothing can be said of its stratigraphic significance.

Locality: Travis County, Onion Creek, near Del Valle- 40 feet above the water's edge.

VAGINULINA PRETENSA n. sp.

Pl. 10, fig. 5

(Holotype- Univ. of Texas Geol. Coll. 49)

Test elongate, complanate, apiculate, about the same width throughout, tapered toward the oral end, dorsal edge straight, truncate, ornamented by three low, sharp, longitudinal ridges, ventral edge slightly curved, truncate, ornamented by two or three low, sharp, longitudinal ridges; primordial chamber bulbulous, ornamented by short, longitudinal costae which extend onto the terminal spine, remaining chambers 5 to 6, long, narrow, broader than high; sutures marked by clear, oblique lines, slightly depressed; aperture terminal, protruding, radiate.

Length up to 1 mm.

This species is quite similar to V. webbervillensis Carsey but the greater width of the latter makes the differentiation easy.

Only one specimen was found so nothing can be said of its vertical range.

Locality: Travis County, Onion Creek, near Del Valle, 35 feet above the water's edge.

VAGINULINA GRACILIS Plummer var. CRETACEA Plummer

Pl. 9, fig. 5

(Plesiotype- Univ. of Texas Geol. Coll. 50)

Vaginulina gracillis Plummer var. cretacea Plummer, 1926, Univ. of Texas Bull. 2644, p. 172, pl. 2, fig. 8.

Test large, elongate, compressed, slightly curved, periphery acutely rounded, the margin opposite the aperutre most acute, tapered from the almost truncate anterior end to the rounded posterior end; chambers numerous, all broader than high; sutures oblique in early portion to less oblique later, indistinct except for the elongate, thickened nodes lying along each side of the test, borne by all except those separating the earliest chambers, not depressed, except between the last two or three chambers; wall thicky aperture eccentric, radiate, protruding.

Length up to 3.5 mm.

This form closely resembles V. gracillis Plummer found in the lower Midway clays. The minerlization of the Cretaceous form and the presence of the thickened sutural nodes serve to differentiate them. V. gracilis var. cretacea is not abundant in the Webberville.

Locality: Travis County, Onion Creek, near Del Valle, 55 feet above the water's edge.

VAGINULINA BREVIS n. sp.

Pl. 13, fig. 1

(Holotype- Univ. of Texas Geol. Coll. 51)

Test small, elongate, compressed, oval in cross section, tapered slightly toward the rounded initial end; primordial chamber bulbous

in the megalospheric form, remaining chambers broader than high, except for the final one which is about as long as broad and slightly inflated; sutures oblique, distinct dark lines more restricted in the later portion; wall smooth; aperutre eccentric, radiate, protruding.

Length about 0.60 mm.

This species occurs sparingly in the Webberville. It has not been observed in any other formation in the Texas geologic section.

Locality: Travis County, Onion Creek, near Del Valle, 33 feet above the water's edge.

Genus PLANULARIA Defrance, 1824

PLANULARIA MULTISTRIATA n. sp.

Pl. 13, fig. 2

(Holotype- Univ. of Texas Geol. Coll. 52)

Test elongate, compressed, periphery carinate, dorsal edge slightly curved, ventral edge curved and slightly lobulated; chambers 4 to 7, slightly inflated, oblique, initial chamber inclined to be somewhat bulbous and exhibiting a tendency toward incoiling; sutures distinct, oblique, curved depressed; wall ornamented by numerous longitudinal, fine, parallel striae arising independently on each chamber; aperture terminal, radiate, protruding.

The long slender specimens with seven chambers may represent the microspheric forms while the shorter, broader specimens with few chambers probably are the megalospheric forms.

Length 0.90- 1.25 mm.

This species is found sparingly in the Webberville, principally in the upper portion.

Locality: Travis County, Onion Creek, near Del Valle, 25 feet above the water's edge.

Genus FRONDICULARIA Defrance, 1824

FRONDICULARIA OLDHAMI Plummer

Pl. 11, fig. 1

(Plesiotype- Univ. of Texas Geol. Coll. 53)

Frondicularia oldhami Plummer, 1926, Univ. of Texas Bull. 2644, p. 117, fig. 12 (text fig.)

Test elongate, lanceolate, much compressed, rounded posteriorly and tapered anteriorly, periphery thin, subcarinate; initial chambers closely incoiled, this whole portion slightly inflated, remaining chambers sagittate; sutures indistinct, marked by dark lines, very faintly depressed; wall smooth; aperture radiate, protruding.

Length up to 1.3 mm.

Perfect specimens of this species are rare. The stouter initial portion is found most frequently. F. oldhami occurs sparingly in the lower Midway clays and in the Webberville.

Locality: Hays County, on the road from Niederwald to Lockhart- Sta. 1.

FRONDICULARIA ARCHIACIANA d'Orbigny var. STRIGILLATA Bagg

Pl. 11, fig. 2

(Plesiotype- Univ. of Texas Geol. Coll. 54)

Frondicularia archiaciana Reuss, 1845, Verst. bohm. Kreide, Part I, p. 31, pl. 13, fig. 39.
Frondicularia archiaciana Chapman, 1894, Jour. Roy. Mic. Soc., p. 155, pl. 3, fig. 6.
Frondicularia archiaciana var. strigillata Bagg, 1898, U. S. Geol. Survey Bull. 88, p. 47, pl. 3, fig. 5.

Test elongate, complanate, lanceolate, tapered toward the

apertural end, periphery truncate, slightly lobulated, its sharp edges continuing from the aperture down to the short spine which terminates the bulbular enlargement on the initial end; chambers consisting of the oval proloculum and 5 to 10 long, narrow chambers on each side which lengthen with age; sutures limbate, raised near the median line, becoming almost flush toward the periphery, sometimes interrupted; wall smooth, proloculum ornamented by two sharp ribs in addition to the four peripheral markings, other chambers marked by short, fine, longitudinal striae near the median line and arranged parallel with it; aperture terminal, radiate, protruding.

Length up to 2 mm.

This species is found rarely in the upper Midway and its common occurence in the Webberville and Taylor makes it unimportant as a marker of significance.

Locality: Hays County, on the road from Niederwald to Lockhart- Sta. 2.

FRONDICULARIA RETICULATA (Reuss)

Pl. 11, fig. 3

(Plesiotype- Univ. of Texas Geol. Coll. 55)

Flabellina reticulata Reuss, 1851, Haidinger's Naturw., Abh. IV, p. 30, pl. I, fig. 22.
Frondicularia reticulata Plummer, 1926, Univ. of Texas Bull. 2644, p. 172, pl. 2, fig. 5.

Test broadly sagittate, flattened, periphery truncate, edges carinate; initial chambers incoiled, later chambers V-shaped, narrow and increasing in length toward maturity; sutures con-

spicuous, thin, raised, sagittate; wall ornamented by numerous rather evenly spaced costae extending across the chambers and at right angles to the sutural lines; aperture protruding, terminal.

Length up to 1.5 mm.; greatest width 0.80 mm.

This beautiful species occurs only in the Webberville and very sparingly there.

Locality: Travis County, Onion Creek, near Del Valle, 65 feet above the water's edge.

FRONDICULARIA ALATA d'Orbigny

Pl. 11, fig. 4

(Plesiotype- Univ. of Texas Geol. Coll. 56)

Frondicularia alata d'Orbigny, 1826, Ann. Sci. Nat., Vol. VII, p. 256, No. 2.
Frondicularia alata Parker, Jones, and Brady, 1871, Ann. Mag. Nat. Hist., Ser. IV, Vol. Viii, p. 161, Pl. 10, fig. 66.

Test lanceolate, complanate, tapered gradually toward the oral end and more abruptly toward the aboral end, blunt at the initial extremity but provided with one or two short spines, acute at the apertural end; chambers up to six on one side, long, narrow, of uniform width, increasing in length with age; sutures raised, oblique, extending from the intermedial line to or onto the terminal spine; proloculum swollen, ornamented by longitudinal costae; aperture terminal, protruding, central, round, radiate.

Length about 1 mm.

This species is found rather commonly in both the Webberville and the Taylor so it is not of great diagnostic importance.

Locality: Travis County, Onion Creek, near Del Valle, 30 feet above the water's edge.

Genus FABELLINA d'Orbigny, 1839

FLABELLINA RUGOSA d'Orbigny

Pl. 11, fig. 5

(Plesiotype- Univ. of Texas Geol. Coll. 57)

Flabellina rugosa d'Orbigny, 1840, Mem. Soc. Geol. France, Ser. III, Vol. IV, Part I, p. 23, pl. 2, figs. 4, 5, and 7.
Flabellina rugosa Id., 1846, Foram. Foss. Vienne, p. 93, pl. 21, figs. 13, 14.
Frondicularia rugosa Plummer, 1926, Univ. of Texas Bull. 2644, p. 118, pl. 5, fig. 1; text fig. 13.
Flabellina rugosa Cushman, 1928, Foraminifera, Their Classification and Economic Uses, pl. 55, fig. 9.

Test sub-rhomboid, compressed, periphery truncate, edges carinate; initial chambers incoiled, later chambers V-shaped, long and narrow, increasing in length with age; sutures thin sharp raised lines; wall granular-rugose; aperture protruding, small, oval.

F. rugosa presents numerous variations in outline and degree in which the early coiled portion is embraced by the later sagittate chambers. These variations are in accordance with the progression of the individual from youth to old age.

Length up to 1 mm.

This species is found in basal Midway clays and commonly in the Webberville. The Taylor yields a similar form, one which may be identical. Mrs. Plummer has suggested, however, that this form may be Frondicularia interpunctata (von der March) due to its pustulate chambers.

Locality; Hays County, on the road from Niederwald to Lockhart- Sta. 2.

Genus LAGENA Walker and Jacob, 1798

LAGENA INCIDENTA Carsey

Pl. 12, fig. 1

(Plesiotype- Univ. of Texas Geol. Coll. 58)

Lagena incidenta Carsey, 1926, Univ. of Texas Bull. 2612, p. 30, pl. 4, fig. 12.

Test subovate to ovate, provided with a long slender neck anteriorly and a shorter neck posteriorly; monothalamous, inflated, wall hispid; aperture round, formed by the open end of the anterior neck.

Length 0.75 mm.

L. incidenta occurs commonly in both the Webberville and the Taylor. Its size renders it quite noticeable; other species of Lagena in these formations are much smaller.

Locality: Hays County, on the road from Niederwald to Lockhart- Sta. I.

LAGENA HISPIDA Reuss

Pl. 12, fig. 2

(Plesiotype- Univ. of Texas Geol. Coll. 59)

Lagena hispida Reuss, 1858, Zeit. deutsch. g. Gessal., Vol. 10, p. 434.
Lagena hispida Id., 1862, Sitz. k. Akad. Wiss. Wien, Vol. XLVI, p. 335, pl. 6, figs. 77- 79.
Lagena hispida Terquem and Berthelin, 1875, Mem. Soc. Geol. France, Ser. II, Vol. 10, p. 14, pl. 1, figs. 9 a, c.
Lagena hispida Terquem, 1882, Mem. Soc. Geol. France, Ser. III, Vol. II, p. 28, pl. 1, fig. 13.
Lagena hispida Brady, 1884, Challenger, Vol. IX, (Zool.), p. 459, pl. 57, figs. 1- 4; pl. 59, figs. 2- 5.
Lagena hispida Terquem, 1886, Mem. Soc. Geol. France, Ser. III, Vol. IV, p. 7, pl. 1, figs. 8, 9.
Lagena hispida Haeusler, 1887, Neues Jahrb., Vol. 1, p. 185, pl. 5, figs. 7- 13.

Test small, circular to subcircular, with a slender neck located anteriorly; monothalamous; hispid; aperture formed by the open end of the neck.

Diameter 0.20 to 0.40 mm.

This species occurs very rarely in the basal Webberville, and occasionally in the Taylor.

Locality: Hays County, on the road from Niederwald to Lockhart- Basal Webberville.

LAGENA MUCRONATA Terquem and Berthelin

Pl. 13, fig. 3

(Plesiotype- Univ. of Texas Geol. Coll. 60)

Lagena mucronata Terquem and Berthelin, 1875, Mem. Soc. Geol. France, Ser. II, vol. X, p. 14, pl. 1, figs. 8 a- c.

Test spherical, apiculate; momothalomous; wall very slightly tuberculate; aperture with a very small neck.

Diameter 0.25 mm.

Only one specimen was found in the samples of Webberville examined.

Locality: Travis County, Onion Creek, near Del Valle, 30 feet above the water's edge.

LAGENA BREVISPINA n. sp.

Pl. 13, fig. 4

(Holotype- Univ. of Texas Geol. Coll. 61)

Test large, inflated, subpyriform, apiculate; wall smooth except for two or three short, scattered spines about the base; aperture large, round, radiate.

Diameter 0.40 mm.; length 0.45 mm.

Nothing can be said of the vertical range of this species as only one specimen was found in the samples examined.

Locality: Hays County, on the road from Niederwald to Lockhart- Sta. 2.

Family POLYMORPHINIDAE

Subfamily POLYMORPHININAE

Genus GUTTULINA d'Orbigny, 1826

GUTTULINA COMMUNIS d'Orbigny

Pl. 12, fig. 3

(Plesiotype, Univ. of Texas Geol. Coll. 62)

Guttulina communis d'Orbigny, 1826, Ann. Sci. Nat., Vol. VII, p. 266, No. 15, pl. 12, figs. 1- 4.
Guttulina communis Roemer, 1838, Neues Jahrbuch, p. 385, pl. 3, fig. 29.
Polymorphina communis d'Orbigny, 1846, Foram. Foss. Vienne, p. 224, pl. 13, figs. 6- 8.
Guttulina communis Egger, 1857, Neues Jahrbuch, p. 288, pl. 13, fig. 16- 18.
Polymorphina communis H. B. Brady, Parker, and Jones, 1870, Trans. Linn. Soc., Vol. XXVII, p. 224, pl. 39, fig. 10.
Guttulina communis Terquem, 1878, Mem. Soc. Geol. France, Ser. III, Vol. I, p. 45, pl. 4, figs. 15- 18.
Guttulina communis Id., 1882, Mem. Soc. Geol. France, Ser. III, Vol. II, p. 134, pl. 13, figs. 40- 42.
Polymorphina communis H. B. Brady, 1884, Challenger, Vol. IX, (Zool.), p. 568, pl. 72, fig. 19.
Polymorphina communis Chapman, 1896, Jour. Roy. Mic. Soc. p. 13, pl. 2, fig. 15.
Polymorphina communis Flint, 1899, Ann. Rpt. U. S. Nat. Mus., for 1897, pp 319, pl. 67, fig. 6.
Polymorphina communis Cushman, 1913, U. S. Nat. Mus. Bull. 71, Part III, p. 87, pl. 37, fig. 7.
Polymorphina communis Id., 1920, U. S. Geol. Survey Prof. Paper 128, p. 68, pl. 4, fig. 5.
Polymorphina communis Id., 1923, U. S. Nat. Mus. Bull. 104, Part IV, p. 147, pl. 40, figs. 1, 2.
Guttulina communis Id., 1928, Contrib. Cushman Lab. Foram. Res., Vol. IV, Part I, p. 14.

Test subovate, very slightly compressed, ultimate end gently tapered, posterior end broadly rounded; chambers few, 4 to 5 visible, more posteriorly, much inflated; sutures oblique, deeply depressed; wall thick, polished, smooth; aperture slightly protruding, radiate.

Length 0.40 to 0.50 mm.

This species is sparingly common in the Webberville and occurs also in the basal Midway and higher Tertiaries.

Locality: Travis County, Onion Creek, near Del Valle, 0 feet above the water's edge.

GUTTULINA PROBLEMA d'Orbigny

Pl. 12, fig. 4

(Plesiotype- Univ. of Texas Geol. Coll. 63)

Guttulina problema d'Orbigny, 1826, Ann. Sci. Nat., Vol. VII, p. 266, No. 14.
Guttulina problema Id., 1846, Foram. Foss. Vienne, p. 224, pl. 12, figs. 26- 28.
Guttulina problema Egger, 1857, Neues Jahrbuch, p. 287, pl. 10, figs. 23- 25.
Polymorphina problema H. B. Brady, Parker, and Jones, 1870, Trans. Linn. Soc., Vol. XXVII, p. 225, pl. 39, figs. 11 a, b.
Polymorphina problema H. B. Brady, 1884, Challenger, Vol. IX, (Zool.), p. 568, pl. 72, fig. 20; pl. 73, fig. 1.
Polymorphina problema Id., 1887, Jour. Roy. Mic. Soc., p. 913.
Polymorphina problema Heron-Allen and Earland, 1916, Jour. Roy. Mic. Soc., p. 49.

Test elongate, very slightly compressed, subovate in transverse section, tapering rather sharply anteriorly and abruptly toward the bluntly rounded posterior end; chambers inflated, 4 always visible, increasing in size from the initial end, the last chamber long and somewhat embracing; sutures depressed, slightly curved, oblique; wall smooth, glistening; aperture central, terminal, radiate, protruding.

Length about 0.75 mm.

Only one specimen of this species was found in the samples examined.

Locality: Travis County, Onion Creek, near Del Valle, 30 feet above the water's edge.

GUTTULINA OBLONGA (d'Orbigny)

Pl. 12, fig. 5

(Plesiotype- Univ. of Texas Geol. Coll. 64)

Polymorphina oblonga d'Orbigny, 1846, Foram. Foss. Vienne, p. 232, pl. 12, figs. 29- 31.
Polymorphina uvaeformis Reuss, 1855, Zeit. d. deutsch. geol. Gesell., Vol. VII, p. 289, fig. 5.
Polymorphina guttata id., 1870, Sitz. k. Akad. Wiss. Wien, Vol. LXII, p. 487.
Polymorphina oblonga H. B. Brady, 1884, Challenger, Vol. IX, (Zool.), p. 569, pl. 73, figs. 2 and 4.
Polymorphina oblonga Cushman, 1913, U. S. Nat. Mus. Bull. 71, Part III, p. 88, pl. 37, fig. 6.

Test elongate, somewhat rhomboid in outline, slightly compressed, roughly oval in cross section; chambers inflated, 6 visible, increasing in size toward the oral end; sutures faintly curved, depressed; wall smooth, glistening; aperture terminal, radiate.

Length about 0.75 mm.

Only one specimen was found in the samples of Webberville examined. This species occurs commonly, however, with G. communis d'Orbigny and G. problema d'Orbigny.

Locality: Travis County, Onion Creek, near Del Valle, 25 feet above the water's edge.

GLOBULINA LACTEA (Walker and Jacob)

Pl. 14, fig. 1

(Plesiotype- Univ. of Texas Geol. Coll. 65)

Serpula lactea Walker and Jacob, 1798, Adam's Essays, ed. 2, p. 634, pl. 24, fig. 4.
Polymorphina lactea Williamson, 1858, Rec. Foram. Gr. Brit., p. 71, pl. 6, fig. 147.
Polymorphina lactea Parker and Jones, 1870, Trans. Linn. Soc., Vol. XXVII, p. 213, pl. 39, fig. 1.
Polymorphina lactea H. B. Brady, 1884, Challenger, Vol. IX, (Zool.), p. 559, pl. 71, fig. 11.
Polymorphina lactea Burrows, Sherborn, and Bailey, 1896, Jour. Roy. Mic. Soc., p. 561, pl. 11, fig. 9.
Polymorphina lactea Chapman, 1896, Jour. Roy. Mic. Soc., p. 9, pl. 2, fig. 3.
Polymorphina lactea Sidebottom, 1907, Mem. and Proc. Manchester Lit. Phil. Soc., Vol. LI, No. 9, p. 9, pl. 2, fig. 11.
Polymorphina lactea Cushman, 1913, U. S. Nat. Mus. Bull. 71, Part III, p. 84, pl. 34, fig. 8.
Polymorphina lactea Id., 1920, U. S. Geol. Survey Prof. Paper 128, p. 68, pl. 11, figs. 3, 4.
Polymorphina lactea Id., 1923, U. S. Nat. Mus. Bull. 104, Part IV, pl. 146, pl. 39, figs. 9, 11.

Test subovate, broadest in the initial portion; chambers few, 3 to 4, oblique, slightly inflated; sutures oblique, not depressed; wall smooth, glistening; aperture radiate.

Diameter 0.25- 0.30 mm.

From G. gibba (d'Orbigny) this species may be distinguished by its smaller size, the slight inflation of chambers, and its more oblique sutures. Guttulina communis d'Orbigny is a much larger form with inflated chambers and depressed sutures.

G. lactea is common in the basal Midway and is found rarely in the Webberville.

Locality: Travis County, Union Creek, near Del Valle, 25 feet above the water's edge.

GLOBULINA LACTEA (Walker and Jacob)

(fistulose form)

Pl. 14, fig. 2

(Plesiotype- Univ. of Texas Geol. Coll. 66)

Test subovate, somewhat flattened; chambers few, only three visible in this specimen, very slightly inflated; sutures oblique, not depressed; wall smooth.

Only one specimen was found. It is included merely to indicate the existence of fistulose forms in the Webberville.

Locality: Travis County, Onion Creek, near Del Valle, 20 feet above the water's edge.

RAMULINA sp.

Pl. 14, fig.3

(Holotype- Univ. of Texas Geol. Coll. 67)

Only one specimen was found in the Webberville material examined. Seven stolen tubes branch from the smooth, swollen part of the test. This specimen closely resembles R. globifera Brady except for the smoothness of its surface. It is included only to show the existence of Ramulina in the Webberville. A similar and perhaps identical form was found by Mrs. Plummer in the Midway.

Locality: Travis County, Onion Creek, near Del Valle, 20 feet above the water's edge.

Family NONIONIDAE

Genus NONION Montfort Montfort, 1808

NONION TURGIDA (Williamson)

Pl. 14, fig. 4 a, b

(Plesiotype- Univ. of Texas Geol. Coll. 68)

Rotalina turgida Williamson, 1858, Rec. Foram. Gt. Brit., p. 50, pl. 4, figs. 95- 97.
Nonionina turgida H. B. Brady, 1884, Challenger, Vol. IX, (Zool.), p. 731, pl. 109, figs. 17- 19.
Nonionina turgida Cushman, 1914, U. S. Nat. Mus. Bull. 71, Part IV, p. 29, pl. 15, fig. 3.

Test subovate in outline, bilaterally symmetrical to slightly unsymmetrical, umbilicate; chambers 8 to 9, enlarging gradually with maturity, not inflated except for the final chamber which is broadly inflated and embracing; sutures depressed; wall smooth; aperture a small opening at the base of the final segment.

Length up to 0.25 mm.

This species is found rarely throughout the Midway and it occurs frequently in the upper Webberville.

Locality: Travis County, Onion Creek, near Del Valle, 40 feet above the water's edge.

NONION SCAPHA Fichtel and Moll

Pl. 14, fig. 5 a, b, c

(Plesiotypes- Univ. of Texas Geol. Coll. 69)

Nonionina scapha Jones, Parker, and Brady, 1866, Crag Foram., Pal. Soc., XIX, pl. 2, figs. 36, 37.
Nonionina scapha Brady, 1867, Nat. Hist. Trans. Northumb. I, 1865- 67, p. 106, pl. 12, fig. 10 a, b.
Nonionina scapha Terrigi, 1883, Atti Acc. Pont. Nuovi Lincei, Vol. XXXV, p. 202, pl. 4, fig. 47.
Nonionina scapha Brady, 1884, Challenger, Vol. IX, (Zool.), p. 730, pl. 109, fig. 14, 15.
Nonionina scapha Brady, Parker, and Jones, 1888, Trans. Zool. Soc., Vol. XII, p. 230, pl. 43, fig. 20.

Test broadly oval in outline, umbilicate, slightly compressed in the initial portion, inflated above, periphery obtuse to rounded; chambers 8 to 9, increasing rapidly in size, the face of the final chamber and rather flattened, embracing; sutures distinct, depressed, faintly; wall smooth; aperture a small orifice at the base of the final chamber.

Length about 0.25 mm.

This species occurs sparingly in the Webberville.

Locality: Travis County, Onion Creek, near Del Valle, 40 feet above the water's edge.

Family HETEROHELICIDAE

Genus GUEMBELINA Egger, 1899

GUEMBELINA GLOBULOSA (Ehrenberg)

Pl. 15, fig. 1

(Plesiotype- Univ. of Texas Geol. Coll. 70)

Textularia globulosa Ehrenberg, 1846, Williamson, Mem. Lit. Phil. Soc. Manchester, Ser. 11, Vol. VIII, p. 76.
Textularia globulosa Id., 1847, Abh. Akad. Wiss. Berlin, p. 446, pl. 2, figs. 78, 79.
Guembelina globulosa Moreman, 1927, Jour. of Paleon. Vol. 1, No. 1, p. 99, pl. 16, fig. 10.

Test elongate, tapered toward the sharply pointed initial end, broad at the oral end, periphery broadly rounded; chambers biserial, 6 to 7 on each side, subglobular, inflated; sutures straight, oblique, depressed; wall smooth; aperture elongate, rounded at the ends, lying at the base of the final chamber.

Length up to about 0.60 mm.

This species occurs throughout the Gulf Series and is, for that reason, of little importance as a marker. It has not been found in any overlying beds. Its greater abundance in the lower beds of the Webberville and its lesser occurence in the upper portion indicates the weakening and final extinction of the species.

Locality: Caldwell County, on the road from Niederwald to Lockhart - Sta. 9.

GUEMBELINA EXCOLATA Cushman

Pl. 15, fig. 2

(Plesiotype- Univ. of Texas Geol. Coll. 71)

Guembelina excolata Cushman, 1926, Contrib. Cushman Lab. Foram. Res., Vol. II, Part I, p. 20, pl. 2, fig. 9.

Test subtriangular, compressed, lateral margins rounded, broadest at the apertural end and tapered at the initial end; chambers biserial, slightly inflated, last one sometimes smaller than the preceding ones; sutures straight, oblique, slightly depressed; wall calcareous, marked by coarse, discontinuous striae arising at the intermedial line of sutures and extending out and downward; aperture at the base of the last chamber.

Length 0.50 mm.

This species is found very sparingly in the Webberville.

Locality: Travis County, Onion Creek, near Del Valle, 10 feet above the water's edge.

Genus PSEUDOTEXTULARIA Rzehak, 1886

PSEUDOTEXTULARIA FRACTICOSA (Egger)

Pl. 15, fig. 3

(Plesiotype- Univ. of Texas Geol. Coll. 72)

Pseudotextularia fracticosa Egger, 1899, Abh. kon. bay. Akad Wiss. Munchen, Cl. II, Vol. XXI.
Pseudotextularia fracticosa Thomas and Rice, 1927, Jour. of Paleont., Vol. I, No. 2, p. 143, 144, fig. 1, No. 11.

Test subtriangular or fan-shaped, flattened, aboral end sharply pointed, chambers planospiral at least in the initial portion of microspheric forms, later chambers subglobular, arranged in a more or less spiral manner about the upper portion of the test; wall ornamented by numerous fine, parallel striae arising independently and running the length of the chambers; aperture large, broad, arched.

Length 0.50 mm.

This species is characteristic of the upper Webberville faunule.

Locality: Travis County, Onion Creek, near Del Valle, 40 feet above the water's edge.

PSEUDOTEXTULARIA COMPRESSA n. sp.

(megalospheric form)

Pl. 15, fig. 4 a,b

(Plesiotype- Univ. of Texas Geol. Coll. 73)

Pseudotextularia b, 1926, Plummer, Univ. of Texas Bull. 2644, p. 172, pl. 2, fig. 2 a, b.

Test elongate, tapered, compressed; early chambers very small, later chambers subglobular, biserial, quite oblique; su-

tures distinct, oblique, depressed, median line almost straight; ornamented by numerous fine, parallel striae originating on each chamber at the median line of sutures and extending out and downward; aperture large, highly arched, faintly rimmed.

Length 0.50 mm.

This is another species diagnostic of the Webberville.

Locality: Travis County, Onion Creek, near Del Valle, 40 feet above the water's edge.

PSEUDOTEXTULARIA INFLATA n. sp.

Pl. 15, fig. 5 a, b

(Plesiotype- Univ. of Texas Geol. Coll. 74)

Pseudotextularia c, Plummer, 1926, Univ. of Texas Bull. 2644, p. 172, pl. 2, fig. 3 a, c.

Test large, tapered; chambers biserial, increasing rapidly in size from the small, somewhat flattened, initial chambers to the final ones which are three times as large as the preceding pari and greatly inflated; sutures distinct, straight, depressed; wall ornamented by medium coarse striae extending the length of the chambers; aperture large, broad, rounded at the ends, faintly rimmed.

Length up to 0.75 mm.

This species is easily distinguished from the other Pseudotextularian forms by the size and inflation of the final chambers at maturity.

P. inflata is diagnostic of the Webberville. The specimen figured is from the upper beds of the formation.

Locality: Travis County, Onion Creek, near Del Valle, 0 feet above the water's edge.

PSEUDOTEXTULARIA COSTATA n. sp.

Pl. 16, fig. 1 a, b

(Plesiotype- Univ. of Texas Geol. Coll. 75)

Pseudotextularia a, Plummer, 1926, Univ. of Texas Bull. 2644, p. 172, pl. 2, fig. 1.

Test elongate, tapered, compressed, parallel to a plane passing through the median line of sutures, about twice as thick as wide; chambers increasing gradually in size from the sharply pointed initial end, narrow in front view, very broad and low in side view; sutures distinct, forming a zigzag line down the center of the test, arched gently in side view; wall ornamented by numerous, moderately fine, longitudinal striae; aperture very broad, low but arched, faintly rimmed.

Length up to 0.60 mm.

This species is conspicuous for the thickness of its test, its narrowness in front view, and the truncation of the final chamber.

In the upper Webberville specimens of this species are moderately common.

Locality: Travis County, Onion Creek, near Del Valle, 40 feet above the water's edge.

PSEUDOTEXTULARIA COMPACTA n. sp.

Pl. 16, fig. 2 a, b

(Plesiotype- Univ. of Texas Geol. Coll. 76)

Pseudotextularia d Plummer, 1926, Univ. of Texas Bull. 2644, p. 172, pl. 2, fig. 4.

Test elongate, tapered to a point at the initial end; chambers biserial, inflated, compact, gradually increasing in size toward maturity; sutures distinct, depressed; wall ornamented by distinct but fine striae; aperture elongate, low, gently arched, faintly rimmed, located at the base of the final chamber.

Length up to 0.55 mm.

This is another of the Pseudotextularian forms found so commonly in the upper Webberville.

Locality: Travis County, Onion Creek, near Del Valle, 40 feet above the water's edge.

Genus PSEUDOUVIGERINA Cushman, 1927

PSEUDOUVIGERINA CRISTATA (Marsson)

Pl. 16, fig. 3

(Plesiotype- Univ. of Texas Geol. Coll. 77)

Uvigerina cristata Marsson, 1878, Mitth. Nat. Ver. Neu-Vorpommern u. Rugen, Jahrg. 10, p. 150, pl. 3, figs. 20 a- c.
Pseudouvigerina cristata Cushman, 1927, Contrib. Cushman Lab. Foram. Res., Vol. II, Part IV, p. 81.

Test small, elongate, tapered slightly, subtriangular in cross section, peripheral margins truncate; initial chambers biserial, later chambers triserial and slightly inflated; sutures distinct, depressed; wall smooth; aperture terminal, round, with a tubular neck.

Length up to 0.50 mm.

This species occurs sparingly in the Webberville.

Locality: Travis County, Onion Creek, near Del Valle, 25 feet above the water's edge.

Family BULIMINIDAE

Genus BULIMINA d'Orbigny, 1826

BULIMINA PUPOIDES d'Orbigny

Pl. 16, fig. 4

(Plesiotype- Univ. of Texas Geol. Coll. 78)

Bulimina pupoides d'Orbigny, 1846, Foram. Foss. Vien, p. 185, pl. 11, figs. 11, 12.
Bulimina pupoides Williamson, 1858, Rec. Foram. Gt. Brit., p. 62, pl. 5, figs. 124, 125.
Bulimina presli var. pupoides Parker and Jones, 1862, Introd. Foram., Appendix, p. 311.
Bulimina pupoides Terrigi, 1880, Atti della Accad. Pont., ann. XXXVI, p. 193, pl. 2, figs. 30- 34.
Bulimina pupoides Brady, 1884, Challenger, p. 400, pl. 50, fig. 15 a, b.

Test short, stout, cylindrical, tapered toward the bluntly pointed oral extremity, aboral end broadly rounded; chambers in whorls, three to each whorl, irregularly disposed about the longitudinal axis, later ones the largest, little inflated; sutures faintly depressed;wall smooth; aperture a vertical slit with a plate-like tooth, at the base of the septal face.

Length 0.50- 0.60 mm.

B. pupoides is very similar to B. quadrata Plummer found in the upper Midway. From this species it may be distinguished by the greater inflation of its chambers and the bluntness of the initial end.

This species is common throughout the Webberville formation.

Locality: Travis County, Onion Creek, near Del Valle, 40 feet above the water's edge.

BULIMINA ACULEATA d'Orbigny

Pl. 16, fig. 5

(Plesiotype- Univ. of Texas Geol. Coll. 79)

Bulimina aculeata d'Orbigny, 1826, Ann. Sci. Nat., Vol. VII, p. 269, Modele No. 7.
Bulimina aculeata Reuss, 1850, Denk, Akad. Wiss. Wien, Vol. 1, p. 374, pl. 47, fig. 13.
Bulimina aculeata Jones, Parker, and Brady, 1866, Crag. Foram, Pal. Soc., Vol. XIX, pl. 3, figs. 1, 2.
Bulimina aculeata Brady, 1884, Challenger, p. 406, pl. 51, figs. 7- 9.
Bulimina aculeata Brady, Parker, and Jones, 1888, Trans. Zool. Soc., Vol. XII, p. 220, pl. 43, fig. 8.
Bulimina aculeata Flint, 1899, Ann. Rpt. U. S. Nat. Mus., for 1897, pl. 37, fig. 4.
Bulimina aculeata Cushman, 1911, U. S. Nat. Mus. Bull. 71, Part II, p. 86, figs. 139 a, b (text).
Bulimina aculeata Id., 1921, U. S. Nat. Mus. Bull. 100, Vol. IV, p. 161, pl. 31, fig. 5.
Bulimina aculeata Id., 1922, U. S. Nat. Mus. Bull. 104, Part III, p. 96, pl. 22, figs. 1, 2.

Test elongate, tapered, apiculate; chambers numerous, inflated, overlapping, arranged in whorls of three chambers each; sutures depressed; early and intermediate chambers ornamented by numerous short spines, later chambers smooth; aperture a curved slit lying at the base of the final chamber.

Length up to 0.50 mm.

This species is of no stratigraphic importance since it occurs frequently in the upper Midway and rarely in the Webberville.

Locality: Well sample- 800- 812 feet.

Genus BOLIVINA d'Orbigny, 1839

BOLIVINA GEMMA Cushman

Pl. 17, fig. 1 a, b

(Plesiotype- Univ. of Texas Geol. Coll. 80)

Bolivina gemma Cushman, 1927, Contrib. Cushman Lab. Foram. Res., p. 87, pl. 12, figs. 3 a, b.

Test elongate, compressed, initial end bluntly pointed, tapered toward the rounded apical end; chambers biserial, 7 to 8 on each side, low, broad; sutures straight, oblique, somewhat limbate, marked by clear, triangular nodes at the median line of sutures; test calcareous, smooth; aperture terminal, an elongate slit.

Length up to 1 mm.

This is a common species in the Webberville formation.

Locality: Hays County, on the road from Niederwald to Lockhart- Sta. 1.

BOLIVINA TEGULATA Reuss

Pl. 17, fig. 2

(Plesiotype- Univ. of Texas Geol. Coll. 81)

Bolivna tegulata Reuss, 1851, Haidinger's Naturw. Abhandl., Vol. IV, p. 29, pl. 4, fig. 12.
Bolivina tegulata Egger, 1899, Abhandl. kon. bay. Akad. Wiss. Munchen, Cl. II, Vol. XXI, Part 1, p. 45, pl. 16, figs. 10-11.
Bolivina tegulata Franke, 1925, Abhandl. geol. pal. Instit. Univ. Greifswald, Vol. VI, p. 21, pl. 2, fig. 7.
Bolivina tegulata Cushman, 1927, Contrib. Cushman Lab. Foram. Res., Vol. II, Part IV, p. 86, 87, pl. 12, fig. 2.

Test elongate, compressed, oral extremity rounded, tapered toward the subacute aboral extremity, lateral margins rounded;

chambers numerous, almost as high as broad, biserial, 9 to 10 on each side, increasing in size with age; sutures straight, slightly depressed, oblique; wall smooth; aperture an elongate slit.

Length up to 0.45 mm.

This species has been reported from the Webberville, the Taylor, and the Brownstown marl.

Locality: Hays County, on the road from niederwald to Lockhart- Sta. 1.

BOLIVINA INCRASSATA Reuss

Pl. 17, fig. 3 a, b

(Plesiotype- Univ. of Texas Geol. Coll. 82)

Bolivina incrassata Reuss, 1851, Haidinger's Nat. Abhandl., Vol. IV, p. 29, pl. 4, fig. 13.
Bolivina incrassata Egger, 1899, Abhandl. kon. bay. Akad. Wiss. Munchen, Cl. II, Vol. XXI, Part 1, p. 45, pl. 16, figs. 4,5.
Bolivina incrassata Franke, 1925, Abhandl. geol. pal. instit. Univ. Greifswald, Vol. VI, p. 21, pl. 2, fig. 8.
Bolivina incrassata Cushman, 1926, Contrib. Cushman Lab. Foram. Res., Vol. II, Part I, p. 19, pl. 2, figs. 1 a, b.

Test elongate, compressed, oral end bluntly pointed, tapered toward the obtuse apical extremity; chambers low and broad, biserial, 8 to 9 on each side, increasing in length with age; sutures straight, faintly depressed clear lines; test smooth; aperture large, an elongate slit.

Length up to 1.25 mm.

This species occurs in the Webberville and in the Annona Chalk.

Locality: Hays County, on the road from Niederwald to Lockhart- Sta. 1.

Genus LOXOSTOMUM Ehrenberg, 1854

LOXOSTOMUM PLAITA (Carsey)

Pl. 17, fig. 4 a,b

(Plesiotype- Univ. of Texas Geol. Coll. 83)

Bolivina plaita Carsey, 1926, Univ. of Texas Bull. 2612, p. 26, pl. 4, fig. 2.
Proroporus plaita Cushman, 1927, Contrib. Cushman Lab. Foram. Res., Vol. II, Part IV, p. 89, pl. 12, figs. 7 a, b.
Loxostomum plaita Cushman, 1928, Foraminifera, Their Classification and Economic Uses, pl. 27, fig. 9.

Test elongate, about five times as long as broad, often twisted on its long axis, laterally compressed, tapered posteriorly, anterior extremity subacute, lateral margins narrow, rounded; chambers numerous, biserially arranged, 9 to 10 on each side, lower than broad; sutures narrow dark lines, slightly depressed, oblique, not quite straight, extending entirely across the test in the later portion; wall calcareous, smooth; aperture elliptical, terminal, central.

Length about 0.70 mm.

This species is common in the Webberville and is found occasionally in the Taylor.

Locality: Travis County, Onion Creek, near Del Valle, 0 feet above the water's edge.

Family ROTALIDAE

Subfamily DISCORBISINAE

Genus DISCORBIS Lamarck, 1804

DISCORBIS CORRECTA Carsey

Pl. 17, fig. 5 a,b

(Plesiotype- Univ. of Texas Geol. Coll. 84)

Discorbis correcta Carsey, 1926, Univ. of Texas Bull. 2612, p. 45, pl. 3, figs. 5 a, b.

Test trochoid, compressed, convex dorsally, flat or concave ventrally; peripheral margin acute, lobulated; chambers numerous, the last one larger than the others and slightly inflated, two to three whorls visible on the upper side, 6 to 8 chambers in the last formed whorl; sutures depressed, strongly curved; aperture at the base of the final chamber, slightly ventral.

Diameter from 0.30 - 0.50 mm.

This species is common in the Webberville and in the upper part of the Taylor. It occurs rarely in the Del Rio. Its wide range renders it of little use as a marker.

Locality: Travis County, Onion Creek, near Del Valle, 25 feet above the water's edge.

Genus GYROIDINA d'Orbigny, 1826

GYROIDINA SOLDANII (d'Orbigny) var. WEBBERVILLENSIS n. var.

Pl. 13, fig. 5 a, b

(Holotype- Univ. of Texas Geol. Coll. 85)

Test subcircular, slightly convex dorsally, conical ventrally, periphery rounded; chambers numerous, about two convolutions dorsally and one ventrally, 8 to 9 chambers in the last whorl, full but not inflated; sutures on dorsal side almost straight, slightly oblique, flush, faintly depressed between the last two or three chambers; sutures straight, radial ventrally, flush, very faintly depressed between later chambers; wall smooth, glistening; aperture a long, narrow, faintly rimmed slit at the

base of the broad septal face, lying about half way between the periphery and the umbilicus.

Diameter 0.40 mm.; thickness 0.35 mm.

This species is found aparingly in the Webberville, a variety of the same species, G. soldanii (d'Orbigny) var. aubangulata Plummer, having more chambers and a bluntly angular periphery, occurs in the Midway. The periphery of the type species, described from the Miocene of the Vienna Basin, is more angular than any of the varieties found in the Texas geologic section.

Locality: Hays County, on the road from Niederwald to Lockhart - Sta. 1.

Subfamily ROTALLINAE

ROTALIA CRETACEA Carsey

Pl. 18, fig. 1 a, b

(Plesiotype- Univ. of Texas Geol. Coll. 86)

Rotalia cretacea Carsey, 1926, Univ. of Texas Bull. 2612 p. 48, pl. 5, figs. 1 a, b.

Test trochoid, two to three convolutions visible on the upper side, quite convex ventrally, less convex dorsally, umbilicate, periphery narrowly rounded; chambers numerous, 12 in the last whorl; sutures curved dorsally, slightly depressed between the final chambers, straight and radiate ventrally, slightly depressed; aperture ventral, a narrow slit at the base of the final chamber.

Diameter up to 0.45 mm.

This species is common in the Webberville. It occurs less abundantly in the upper Taylor, and rarely in the Del Rio.

R. cretacea resembles R. aequilateralis Plummer found in the Midway and upper Webberville but the latter is smaller and has fewer chambers. This species is more convex dorsally while the convexity of R. cretacea is greatest on the ventral side.

Locality: Travis County, Onion Creek, near Del Valle, 35 feet above the water's edge.

ROTALIA AEQUILATERALIS Plummer

Pl. 18, fig. 2 a, b, c

(Plesiotype- Univ. of Texas Geol. Coll. 87)

Rotalia aequilateralis Plummer, 1926, Univ. of Texas Bull. 2644, p. 155, pl. 12, figs. 3 a-c.

Test coiled, two and one-half convolutions visible on the under side and one on the upper side, slightly more convex dorsally than ventrally, periphery narrowly rounded, lobate between the final chambers; chambers, 10 in the last formed whorl; sutures straight, radial, slightly elevated near the umbilicus on the ventral side, curved, flush except between the final chambers on the dorsal side; aperture ventral, a narrow slit at the base of the final chamber.

Diameter up to 0.40 mm.

R. aequilateralis is found but rarely in the upper Webberville to which horizon it is confined in the Cretaceous section of Texas. It is found, however, in the overlying Midway, more abundantly in the upper faunule.

Locality: Travis County, Onion Creek, near Del Valle, 40 feet above the water's edge.

Subfamily SIPHONINAE

Genus EPISTOMINA Terquem, 1883

EPISTOMINA PARTSCHIANA (d'Orbigny)

Pl. 18, fig. 3 a, b, c

(Plesiotype- Univ. of Texas Geol. Coll. 88)

Rotalina partschiana d'Orbigny, 1846, Foram. Foss. Vienne, p. 153, pl. 7, figs. 28- 30; pl. 8, figs. 1- 3.
Rotalia elegans Parker and Jones, 1860, Quart. Jour. Geol. Soc., Vol. XVI, p. 455, pl. 20, fig. 46.
Pulvinulina repanda var. elegans Parker and Jones, 1865, Phil. Trans., Vol. CLV, p. 397, pl. 16, figs. 44- 46.
Rotalia flosculiformis Schwager, 1866, Novara- Exped., geol. Theil, Vol. II, p. 262, pl. 7, fig. 109.
Pulvinulina partschiana Reuss, 1870, Sitz. Akad. Wiss. Wien, Vol. LXII, p. 36.
Pulvinulina elegans Blake, 1876, Yorkshire Lias, p. 472, pl. 17, figs. 38, 38 a.
Placentula elegans Berthelin, 1882, Bull. Soc. Geol. France, Ser. III, Vol. II, p. 16.
Pulvinulina partschiana H. B. Brady, 1884, Challenger, p. 699, pl. 105, fig. 3 a, b, c.
Pulvinulina partschiana Flint, 1899, Ann. Rpt. U. S. Nat. Mus. for 1897, p. 331, pl. 75, fig. 3.
Pulvinulina partschiana Millet, 1904, Jour. Roy. Mic. Soc., p. 502.
Pulvinulina partschiana Chapman, 1909, Proc. Roy. Soc. Victoria n. s., Vol. XXII, p. 287.
Pulvinulina partschiana Crohman, 1915, U. S. Nat. Mus. Bull. 71, Part V, p. 64, fig. 60 (text).
Epistomina partschiana Cushman, 1927, Bull. Scripps Inst. Ocean., Tech Ser., Vol. I, No. X, p. 163, pl. 5, figs. 4, 5.

Test subcircular in outline, dorsal side more convex than the ventral, trochoid, two whorls visible on the dorsal side and one on the ventral, periphery subacute, faintly lobate between the later chambers; chambers numerous, later ones slightly inflated, 7 to 9 in the last whorl; sutures on the dorsal

side curved, marked by clear bends flush with the surface except between the last three or four chambers where they are depressed, those on the ventral side curved, radiating from a very small, only slightly elevated, clear, central boss, depressed in the later portion; wall smooth; aperture ventral, extending from the periphery half way to the umbilicus.

Diameter up to 0.45 mm.

This species is found sparingly in the faunule of the upper Midway and the upper Webberville.

Locality: Travis County, Onion Creek, near Del Valle, 25 feet above the water's edge.

Family CHILOSTOMELLIDAE

Subfamily ALLOMORPHINELLINAE

Genus PULLENIA Parker and Jones, 1862

PULLENIA QUINQUELOBA (Reuss)

Pl. 18, fig. 4 a, b

(Plesiotype- Univ. of Texas Geol. Coll. 89)

Nonionina quinqueloba Reuss, 1851, Zeit. deutsch. geol. Gesell., Vol. III, p. 47, pl. 5, fig. 31.
Pullenia sphaeroides Parker and Jones, 1865, Phil. Trans., Vol. CLV, p. 368, pl. 17, fig. 53.
Pullenia quinqueloba H. B. Brady, Parker, and Jones, 1888, Trans. Zool. Soc., Vol. XII, p. 226, pl. 43, figs. 22, 23.
Pullenia quinqueloba Burrows and Holland, 1897, Proc. Geol. Assoc., p. 47, pl. 2, fig. 21.
Pullenia quinqueloba Flint, 1899, Ann. Rpt. U. S. Nat. Mus., for 1897, p. 324, pl. 70, fig. 5.
Pullenia quinqueloba Cushman, 1914, U. S. Nat. Mus. Bull. 71, Part IV, p. 21, pl. 13, fig. 2.
Pullenia quinqueloba Halkyard, 1917, Mem. Proc. Manchester Lit. Phil. Soc., Vol. LXII, p. 104.
Pullenia quinqueloba Cushman, 1924, U. S. Nat. Mus. Bull. 104, Part V, p. 42, pl. 8, figs. 5- 9, and II.

Pullenia quinqueloba Heron-Allen and Earland, 1924, Jour. Roy. Mic. Soc., p. 166.

Test biconvex, slightly asymmetrical, not inflated, involute, periphery rounded, lobulated in later portion; chambers 5 to 6, not inflated, last chamber the largest; sutures distinct but not deeply depressed, only slightly curved; wall smooth; aperture a narrow slit at the base of the relatively large, somewhat triangular apertural face.

Diameter about 0.30 mm.

P. quinqueloba is found sparingly in the Webberville and rarely in the upper Midway.

Locality; Hays County, on the road from Liederwald to Lockhart- Sta. 2.

Family GLOBIGERINIDAE

Subfamily GLOBIGERININAE

Genus GLOBIGERINA d'Orbigny, 1826

GLOBIGERINA CRETACEA d'Orbigny

Pl. 18, fig. 5 a, b

(Plesiotype- Univ. of Texas Geol. Coll. 90)

Globigerina cretacea d'Orbigny, 1840, Mem. Soc. Geol. France, Ser. I, Vol. 4, p. 34, pl. 3, figs. 12- 14.
Globigerina cretacea Reuss, 1845-6, Verstein. Bohm. Kreide, Vol. I, p. 36, pl. 8, fig. 55.
Globigerina cretacea Brady, 1884, Challenger, p. 596, pl. 82, fig. 10 a- c.
Globigerina cretacea Mariani, 1899, Boll. Soc. Geol. Ital., Vol. VII, p. 289, pl. 10, figs. 18, 19.

Test rotaliaform, two and one-half to three convolutions visible on the flattened or slightly convex dorsal side and one

on the ventral side which is depressed toward the umbilicus, periphery rounded, lobulated; chambers small, inflated, 5 to 6 in the last whorl; sutures distinct, straight, depressed; wall coarsely perforate; aperture multiple, opening into the umbilical depression.

Diameter up to 0.50 mm.

G. cretacea is of no importance as a marker because of its wide vertical range. It is found sparingly in the Comanchean and abundantly in the Gulf Series of Texas.

Locality: Travis County, Onion Creek, near Del Valle, 35 feet above the water's edge.

GLOBIGERINA RUGOSA Plummer

Pl. 19, fig. 1 a, b, c, d

(Plesiotype- Univ. of Texas Geol. Coll. 91)

Globigerina rugosa Plummer, 1926, Univ. of Texas Bull. 2644, p. 38, 39, and 172, pl. 2, fig. 10.

Test rotaliaform, two and one-half convolutions visible dorsally, the inner whorls forming an elevated spire, one whorl visible ventrally, depressed toward the umbilicus, periphery rounded, lobulated; chambers inflated, 4 in the last whorl; sutures straight, depressed; wall rugose; aperture rather large, extending from the margin of the final chamber to the umbilicus, with a loosely attached umbilical protective covering.

Diameter about 0.45 mm.

This species, so far as now known, is confined to the Webberville, where it is moderately common.

Locality: Travis County, Onion Creek, near Del Valle, 50 feet above the water's edge.

Family GLOBOROTALIIDAE

Genus GLOBOTRUNCANA Cushman, 1927

GLOBOTRUNCANA ARCA (Cushman)

Pl. 19, fig. 2 a, b, c

(Plesiotype- Univ. of Texas Geol. Coll. 92)

Pulvinulina arca Cushman, 1926, Contrib. Cushman Lab. Foram. Res., Vol. II, Part I, p. 23, pl. 3, figs. 1 2- c.
Globotruncana arca Cushman, 1927, Contrib. Cushman Lab. Foram. Res., pl. 19, fig. 11.

Test unequally biconvex, doubly keeled; all chambers visible on the dorsal side, close coiled in the early portion, 5 to 6 gradually enlarging chambers of the last formed whorl visible on the ventral side, large, deep umbilical depression; sutures depressed and curved slightly on the ventral side, raised and decidedly curved dorsally, having a bead-like ornamentation; wall smooth; aperture opening into the umbilical depression.

Diameter about 0.50 mm. on the average.

This species occurs throughout the Gulf Series but it is most abundant in the Taylor and the Webberville, It is found very sparingly in the Del Rio.

Locality: Travis County, Onion Creek, near Del Valle, 40 feet above the water's edge.

GLOBOTRUNCANA ARCA Cushman var. CONTUSA Cushman

Pl. 19, fig. 3 a, b.

(Plesiotype- Univ. of Texas Geol. Coll. 93)

Pulvinulina arca Cushman var. contusa Cushman, 1926, Contrib. Cushman Lab. Foram. Res., Vol. II, Part 1, p. 23.

Test rotaliaform, plane or slightly concave ventrally and quite convex dorsally, periphery narrow, truncate, with a double keel; chambers numerous, very slightly inflated, all visible on the upper side, only those of the last formed whorl visible on the lower side; sutures depressed, ornamented with small, bead-like prominences; aperture opening into the umbilical depression on the ventral face.

Diameter about 0.75 mm.; thickness 0.65-0.75 mm.

The variety differs from the type in its greater size and pyramidal form as well as the concave appearance of the chambers on the dorsal side.

This foraminifer is moderately common in the Webberville and sparingly common in the Taylor.

Locality: Travis County, Onion Creek, near Del Valle, 25 feet above the water's edge.

GLOBOTRUNCANA PLANOCONVEXA n. sp.

Pl. 19, fig. 4 a, b, c

(Holotype- Univ. of Texas Geol. Coll. 94)

Test thick, trochoid, dorsal side flat to slightly concave, ventral side quite convex, periphery with a double keel; chambers in two and one-half convolutions, 5 to 6 in the last formed

whorl surrounding a depressed umbilical area; sutures distinct, depressed, curved slightly on the dorsal side, marked by a series of bead-like prominences, straight and radial on the ventral side; wall roughened by numerous, low, spinose processes distributed uniformly over the surface, peripheral margins with small bead-like ornamentation; aperture ventral, long, narrow, opening into the umbilical area.

Diameter about 0.50 mm.; thickness about 0.30 mm.

G. planoconvexa very closely resembles Pulvinulina velascoensis Cushman. The latter, however, has seven chambers in the final whorl and in peripheral view is triangular in shape while G. planoconvexa is not.

Locality: Travis County, Onion Creek, near Del Valle, 40 feet above the water's edge.

GLOBOTRUNCANA MARGINATA (d'Orbigny)

Pl. 19, fig. a, b, c

(Plesiotype- Univ. of Texas Geol. Coll. 95)

Globigerina marginata, 1910, Jour. Roy. Mic. Soc., Part IV, pl. 9, figs. 1- 3.
Globigerina marginata Applin, Ellisor, and Kniker, 1925, Amer. Assoc. Pet. Geol., Vol. IX, No. 1, p. 98, pl. 3, fig. 7.

Test trochoid, biconvex, ventral side much less convex than the dorsal, periphery with a double keel; chambers slightly inflated, one and one-half convolutions visible on the dorsal side, 5 chambers in the last whorl; sutures depressed, decidedly curved on the dorsal side, very slightly curved on the

ventral side; wall rugose, peripheral margins and sutural lines ornamented by small bead-like prominences; aperture large, ventral, opening into the large, deep umbilical area.

Diameter 0.50- 0.60 mm.

This species is found sparingly in the Webberville. It has not been reported from any other Cretaceous formation in Texas.

Locality: Hays County, on the road from Niederwald to Lockhart- Sta. 1.

GLOBOTRUNCANA CANICULATA (Reuss)

Pl. 20, fig. 2, b, c

(Plesiotype- Univ. of Texas Geol. Coll. 96)

Sosalina caniculata Reuss, 1854, Denkschr. Akad. Wiss. Wien, Vol. VII, Part I, p. 70, pl. 26, fig. 4.
Globigerina caniculata Egger, 1889, Abhandl. kon. bay. Akad. Wiss. Munchen, Cl. II, Vol. XXI, Part I, p. 172, pl. 21, figs. 15- 17, 24- 26.

Test trochoid, plane both dorsally and ventrally, the sides parallel, periphery truncate, bicarinate; chambers in two convolutions visible on the dorsal side, slightly inflated, 5 in the last formed coil; sutures depressed, curved dorsally, straight ventrally; wall slightly spinose in young specimens, peripheral margins ornamented with bead-like prominences; aperture ventral, large, opening into the deep umbilical area.

Diameter about 0.50 mm.

This species is a typical Webberville form. It also occurs in the Pecan Gap Chalk.

Locality: Hays County, on the road from Niederwald to Lockhart- Basal Webberville.

Family ANOMALINIDAE

Genus ANOMALINA d'Orbigny, 1926

ANOMALINA GROSSERUGOSA (Gumbel)

Pl. 20, fig. 2 a, b

(Plesiotype- Univ. of Texas Geol. Coll. 97)

Truncatulina grosserugosa Gumbel, 1868, Abhandl. k. Akad., Wiss., Cl. II, Vol. X, p. 660, pl. 2, figs. 104 a, b.
Truncatulina grosserugosa Hantken, 1875, Mittheil. Jahrb. k. ung. geol. Anstalt, Vol. IX, p. 74, pl. 9, fig. 6 a, b.
Truncatulina granosa Id., Ibid., p. 74, pl. 10, figs. 2 a, b, and c.
Anomalina grosserugosa Brady, 1884, Challenger, p. 673, pl. 94, figs. 4, 5.
Anomalina grosserugosa Gumbel, 1889, Jour. Roy. Mic. Soc., p. 487, pl. 11, fig. 34.

Test subnautiloid, ventral side convex, dorsal side flat to slightly concave; periphery rounded, sutural constrictions most apparent in the later portion of the outer coil; chambers numerous, the last one slightly larger than the others, all visible from the ventral side where two to three whorls are exposed, only those of the last formed whorl visible on the dorsal side; sutures straight dorsally, arising from the slightly depressed area in the center of the test; sutures curved ventrally; wall conspicuously punctate; aperture at the base of the final chamber, slightly ventral; often gray in color.

Diameter about 0.80 mm.

While this foraminifer occurs in both the Taylor and the Webberville formations, it is most abundant in the latter.

Locality: Travis County, Onion Creek, near Del Valle, 0 feet above the water's edge.

ANOMALINA PSEUDOPAPILLOSA Carsey

Pl. 20, fig. 3 a, b

(Plesiotype- Univ. of Texas Geol. Coll. 98)

Anomalina pseudopapillosa Carsey, 1926, Univ. of Texas Bull. 2612, p. 47, pl. I, figs. 6 a, b.

Test coiled, unequally biconvex, one and one-half to two convolutions visible dorsally, not completely involute ventrally, periphery acutely rounded; chambers numerous, 12 to 13 in the last whorl, small; sutures raised, slightly curved, coarser on the inferior surface where they terminate before reaching the center leaving small portions of preceding sutures and giving to it a papillose appearance; wall finely perforate; aperture dorsal, at the base of the final chamber.

Diameter about 0.45 mm.

This species is common in the upper Webberville.

Locality: Travis County, Onion Creek, near Del Valle, 15 feet above the water's edge.

ANOMALINA NAVARROENSIS Plummer

Pl. 20, fig. a, b, c

(Plesiotype- Univ. of Texas Geol. Coll. 99)

Anomalina navarroensis Plummer, 1926, Univ. of Texas Bull. 2644, p. 172, pl. 2, figs. 6 a, b, and c.

Test unequally biconvex, slightly flattened, completely involute, periphery narrowly rounded; chambers numerous, narrow;

sutures slightly raised in the earlier portion, coarser near the umbilicus, depressed in the later portion, curved, limbations forming bead-like prominences about the umbilicus; wall punctate; aperture dorsal, a slit at the base of the final chamber.

Diameter 0.30 mm.

This form is characteristic of the upper Webberville.

Locality: Travis County, Onion Creek, near Del Valle, 50 feet above the water's edge.

ANOMALINA AMMONOIDES Reuss

Pl. , fig.

(Plesiotype- Univ. of Texas Geol. Coll. 100)

Rosalina ammonoides Reuss, 1845, Verstein, bohm. Kreid., Part I, p. 36, pl. 13, fig. 66; pl. 8, fig. 53.
Rosalina ammonoides Id., 1850, Haidinger's Naturw. Abhandl., Vol. IV, p. 36, pl. 4, fig. 2.
Nonionina bathyomphala Id., 1862, Sitz. k. Akad. Wiss. Wien, Vol. XCVI, p. 95, pl. 13, fig. 1 a, b.
Rosalina mabrica Stache, 1864, Novara-Exped. geol. Theil, Vol. I, p. 282, pl. 24, fig. 32.
Rosalina orbiculus Id., Ibid., p. 285, pl. 24, fig. 34.
Planorbulina ammonoides Parker and Jones, 1865, Phil. Trans., Vol. CLV, p. 379.
Discorbina ammonoides Reuss, 1865, Sitz. k. Akad. Wiss. Wien, Vol. LIII, p. 456, No. 5.
Rotalia capitata Gumbel, 1868, Abhandl. k. bay. Akad. Wiss., Cl. II, Vol. X, p. 653, pl. 2, fig. 92.
Rotalia ammonoides Id., 1870, Sitz. k. bay. Akad. Wiss., p. 283.
Anomalina ammonoides Brady, 1884, Challenger, p. 672, pl. 94, figs. 2, 3.
Anomalina ammonoides Brady, Parker, and Jones, 1888, Trans. Zool. Soc., Vol. XII, p. 228, pl. 45, fig. 19.
Anomalina ammonoides Flint, 1899, Ann. Rpt. U. S. Nat. Mus., for 1897, p. 335, pl. 78, fig. 4.

Test compressed, periphery rounded, slightly lobulated in the later portion, ventral side convex, dorsal side slightly

convex to flattened; chambers numerous, narrow, slightly curved, 13 to 15 in the last whorl; sutures of clear shell material, thickened, curved, slightly raised, limbate, limbations uniting to form a spiral on the ventral side and a solid, slightly raised boss of clear shell material on the dorsal side; wall rather coarsely perforate; aperture a narrow, arched slit at the base of the last chamber, extending on the ventral side toward the umbilicus.

Diameter up to 0.40 mm.

This species occurs in no other Cretaceous formation in Texas so far as is now known.

Locality: Travis County, Onion Creek, near Del Valle, 40 feet above the water's edge.

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PLATES

PLATE I

PLATE I

Figure 1. Reophax texana Cushman and Waters

Figure 2. Ammodiscus incertus (d'Orbigny)

Figure 3. Haplophragmoides excavata Cushman and Waters
a, side view; b, peripheral view.

Figure 4. Textularia semicomplanata Carsey

Figure 5. Gaudryina bulleta Carsey

PLATE I

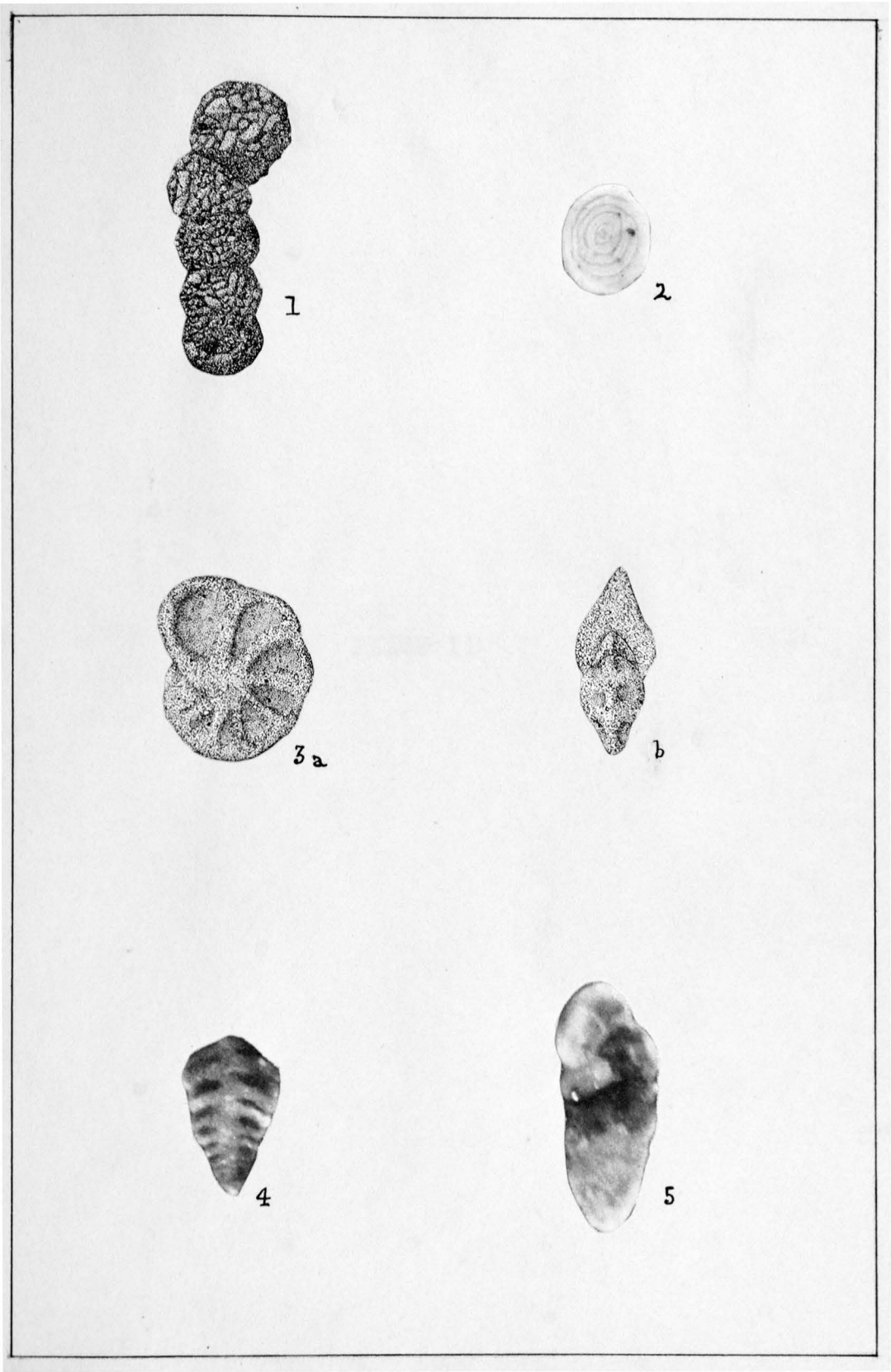

PLATE II

PLATE II

Figure 1. Guadryina pupoides d'Orbigny

Figure 2. Gaudryina rugosa d'Orbigny

Figure 3. Clavulina triquetra Reuss

Figure 4. Quinqueloculina seminulum (Linnaus)

Figure 5. Trochammina diagonis (Carsey)

PLATE II

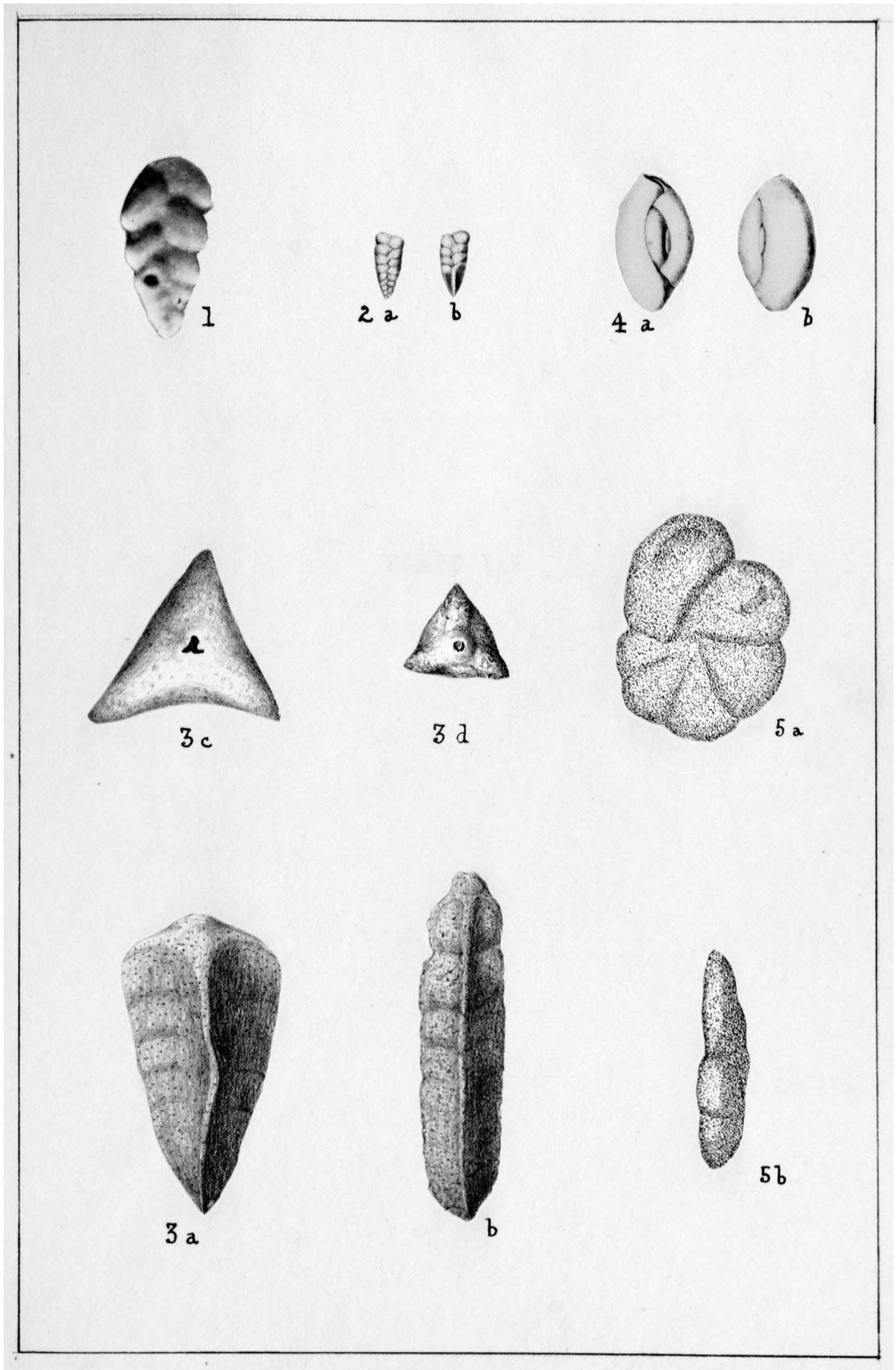

PLATE III

PLATE III

Figure 1. Trochammina texana Cushman and Waters
a, dorsal view; b, ventral view; c, peripheral view.

Figure 2. Lenticulina rotulata (Lamarck)

Figure 3. Lenticulina gibba (d'Orbigny)

Figure 4. Cristellaria scitula Berthelin

Figure 5. Cristellaria navarroensis Plummer
a, side view; b, peripheral view.

PLATE III

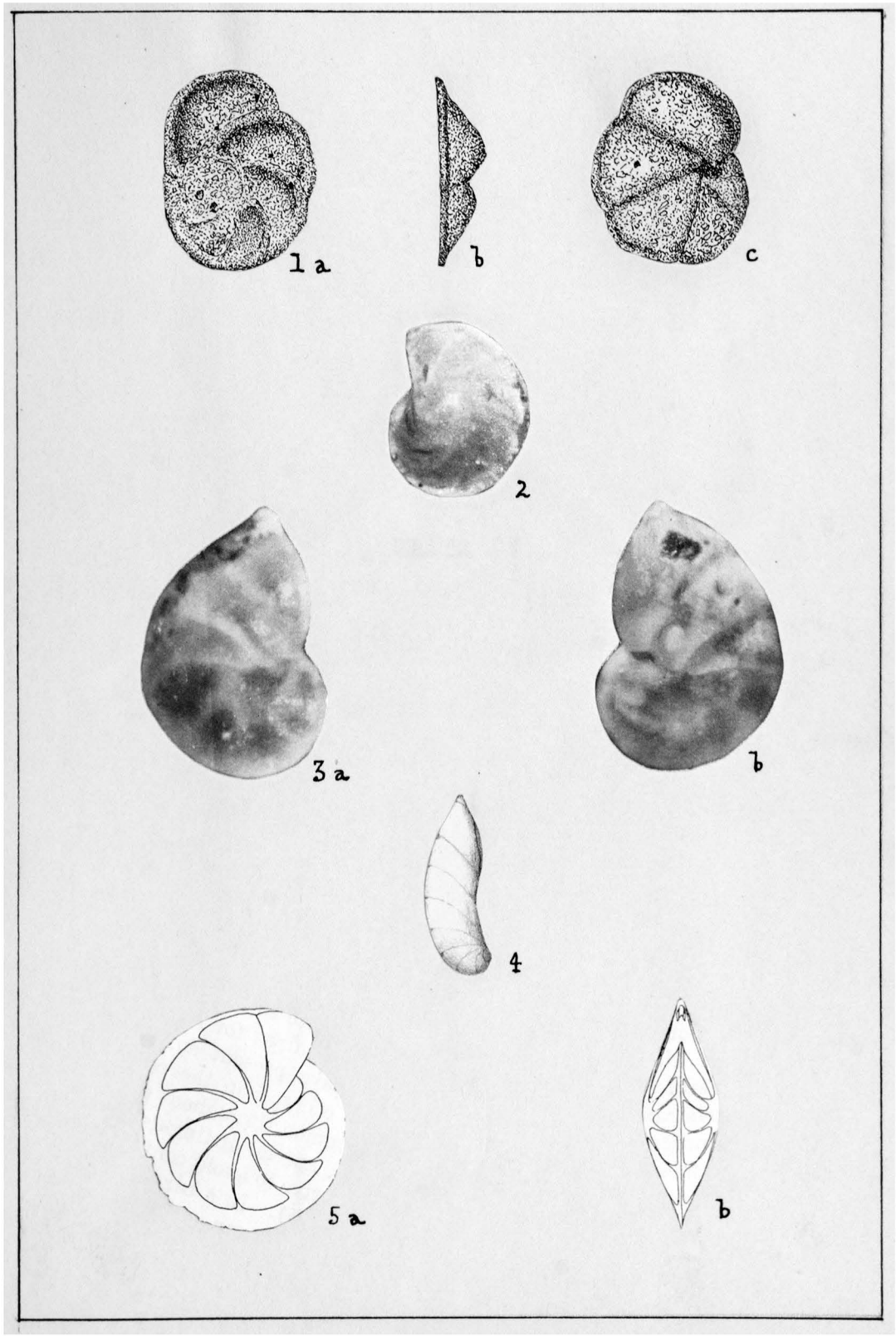

PLATE IV

PLATE IV

Figure 1. *Haplophragmoides complanata* n. sp.

a, dorsal view; b, ventral view

Figure 2. *Haplophragmoides convoluta* n. sp.

Figure 3. *Cristellaria texana* n. sp.

a, side view; b, edge view

Figure 4. *Cristellaria crepidula* Fichtel and Moll

Figure 5. *Cristellaria subcarinata* n. sp.

a, side view; b, edge view

PLATE IV

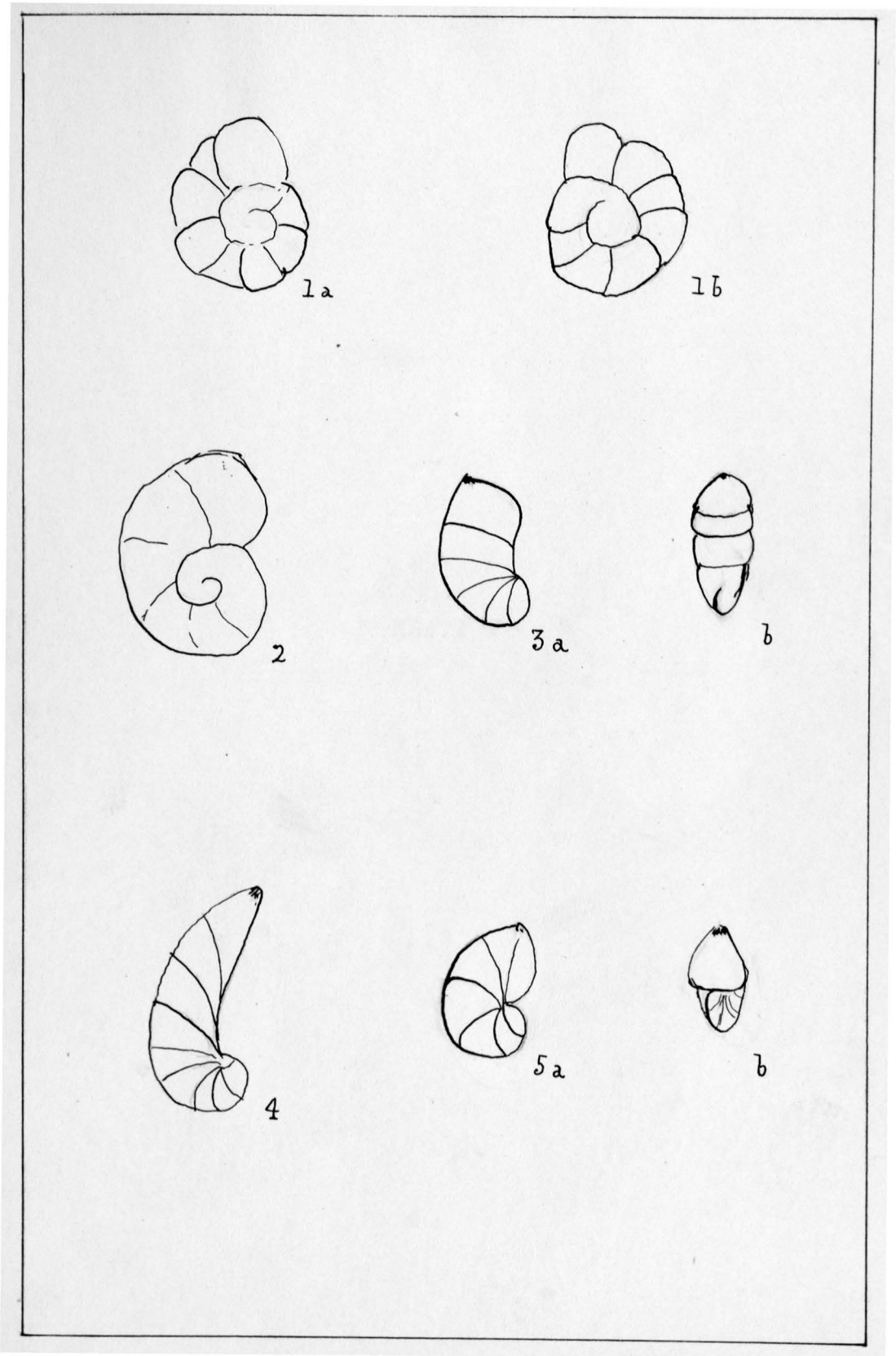

PLATE V

PLATE V

Figure 1. *Marginulina costata* (Batsch)
a, side view; b, edge view.

Figure 2. *Marginulina regularis* d'Orbigny

Figure 3. *Nodosaris granti* Plummer

Figure 4. *Nodosaria spinescens* (Reuss)

Figure 5. *Nodosaria soluta* (Reuss)

PLATE V

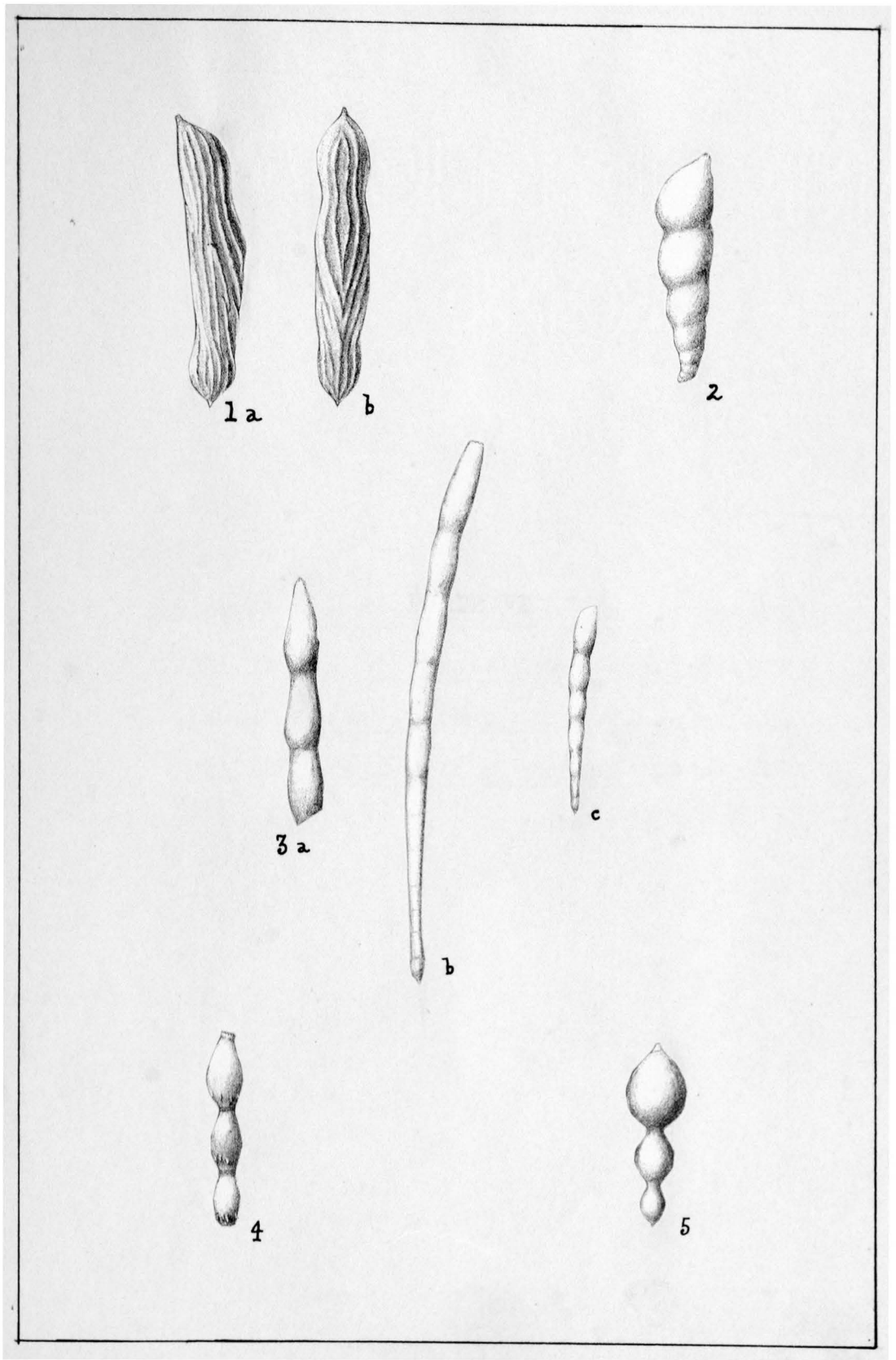

PLATE VI

PLATE VI

Figure 1. Nodosaria mucronata (Neugeboren)

Figure 2. Nodosaria affinis d'Orbigny

Figure 3. Nodosaria poluligera (Stache)

Figure 4. Nodosaria radicula (Linnaeus)

Figure 5. Nodosaria alternata Carsey

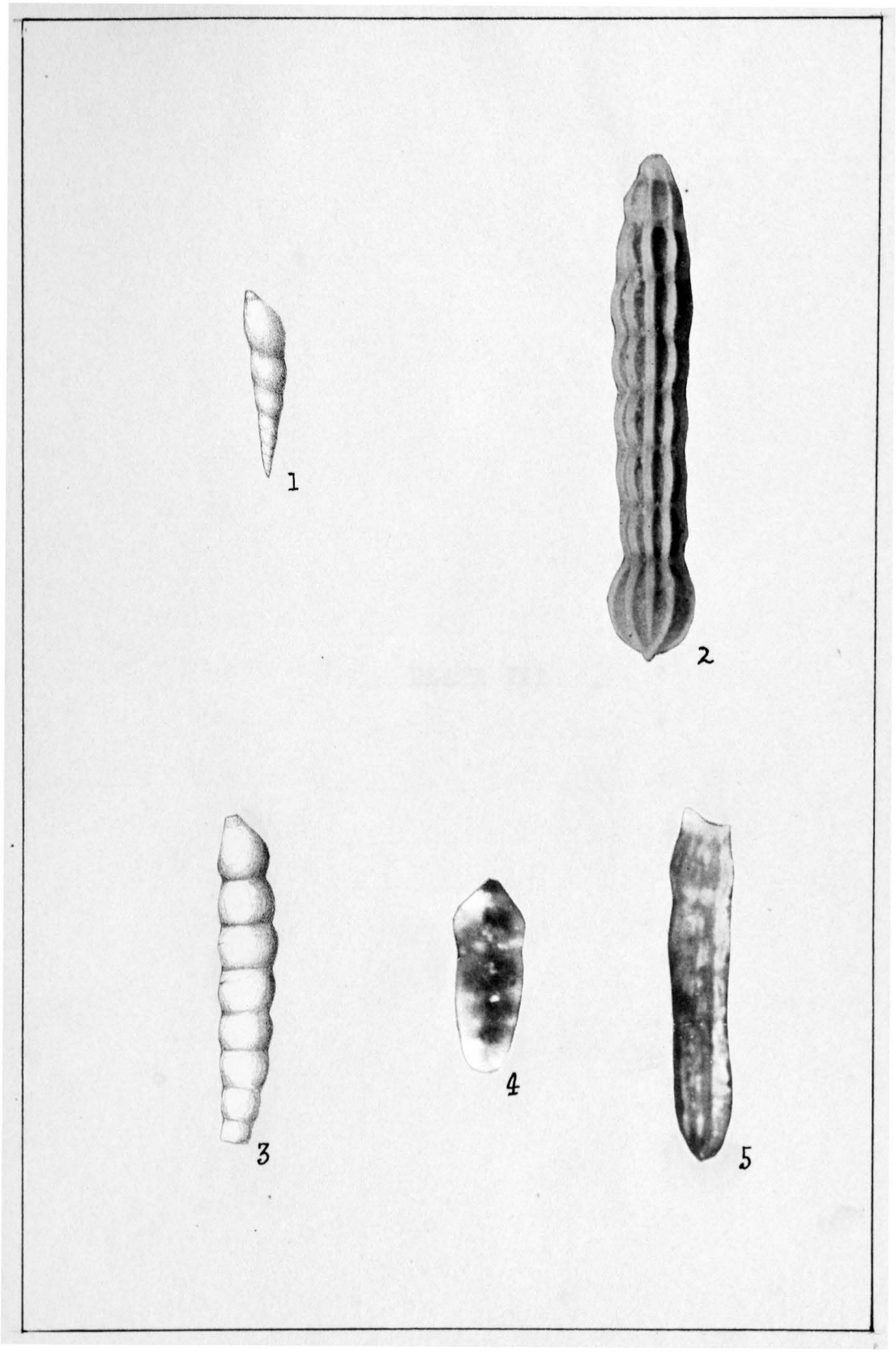
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PLATE VII

PLATE VII

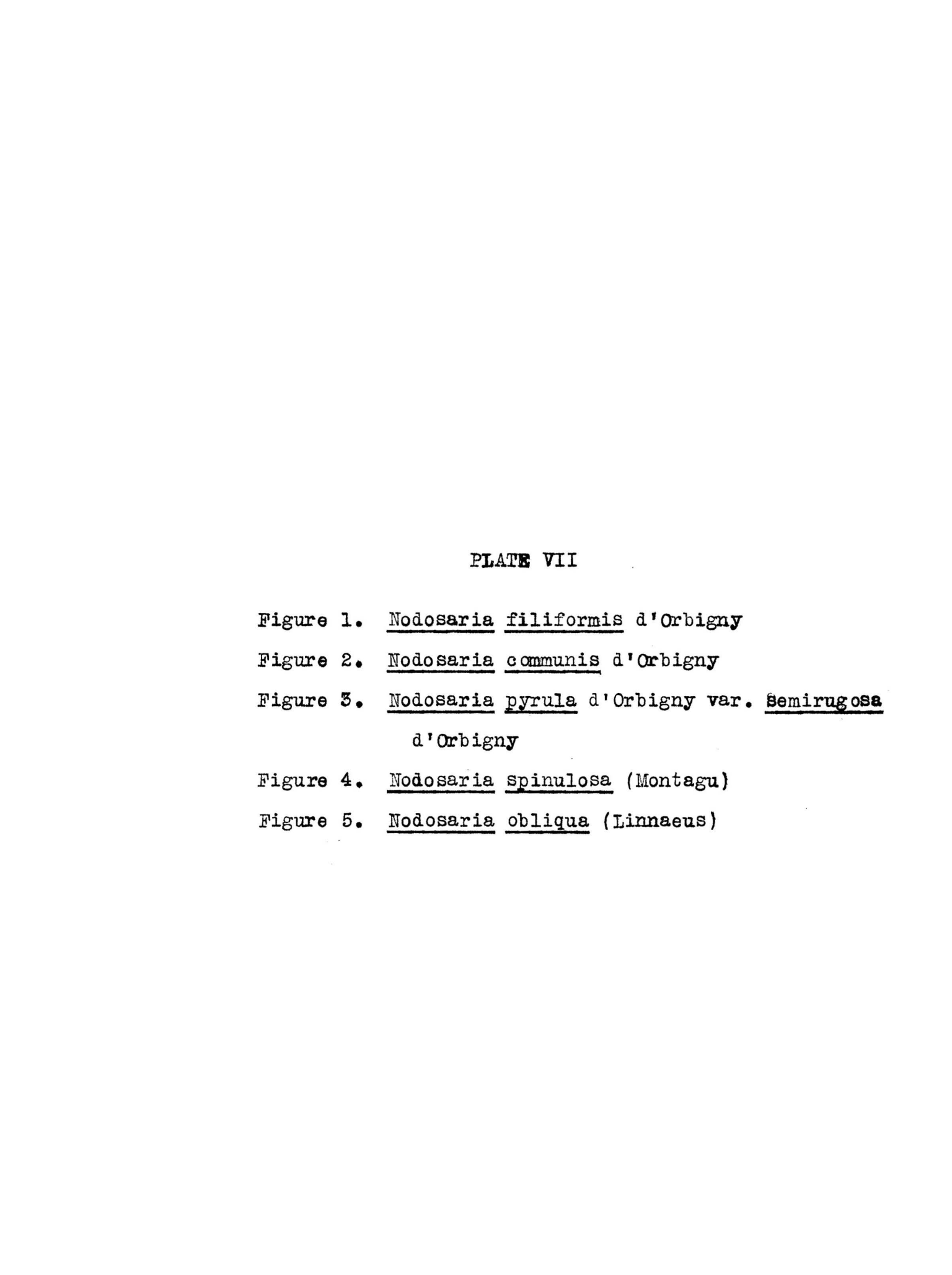

Figure 1. Nodosaria filiformis d'Orbigny

Figure 2. Nodosaria communis d'Orbigny

Figure 3. Nodosaria pyrula d'Orbigny var. semirugosa d'Orbigny

Figure 4. Nodosaria spinulosa (Montagu)

Figure 5. Nodosaria obliqua (Linnaeus)

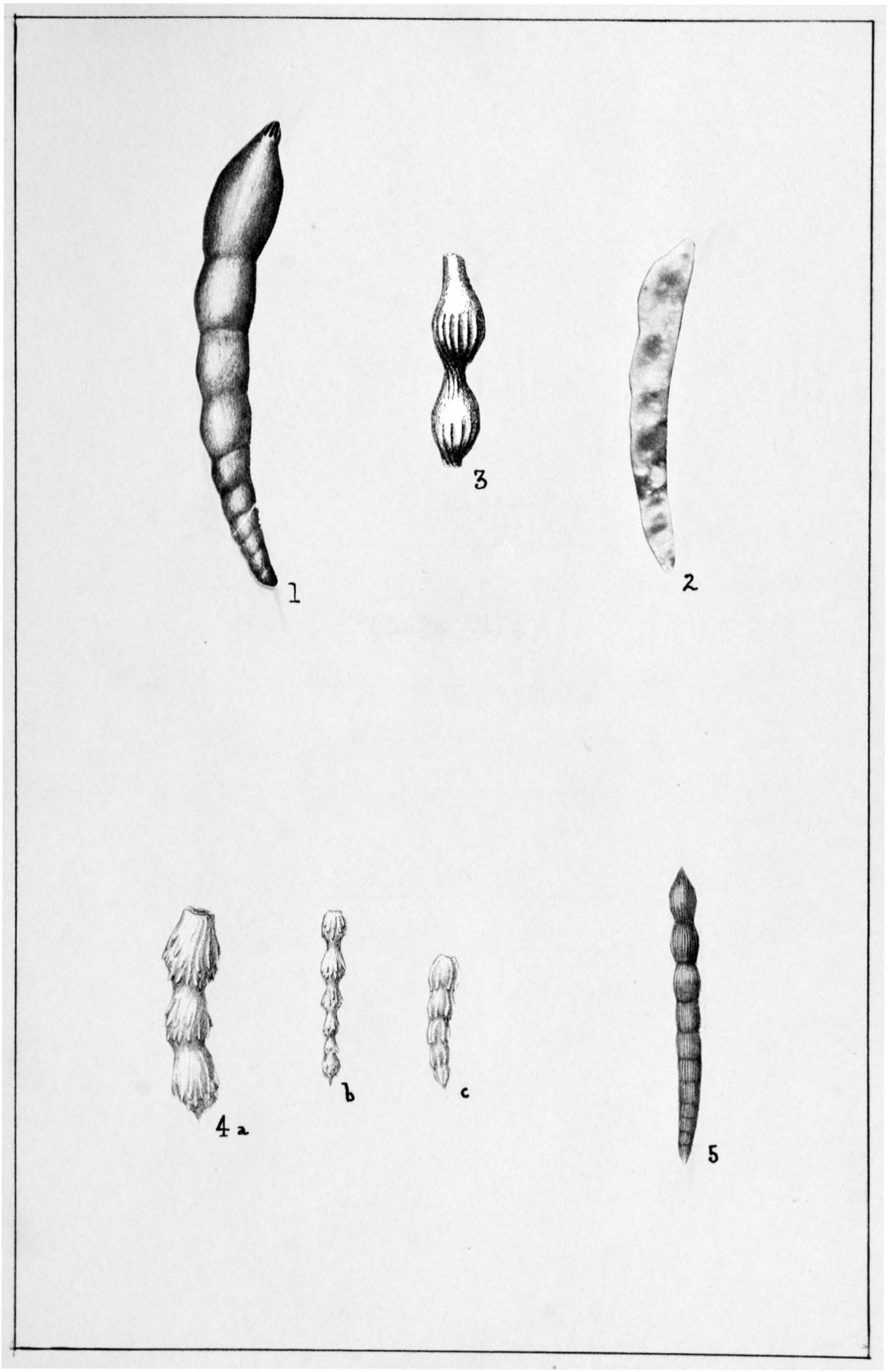
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PLATE VIII

PLATE VIII

Figure 1. Marginulina whitneyi n. sp.

Figure 2. Nodosaria vertebralis (Batsch) var. webbervillensis n. var.

Figure 3. Nodosaria pauaistriata n. sp.

Figure 4. Nodosaria elongaloculata n. sp.

Figure 5. Nodosaria scalariformis n. sp.

PLATE VIII

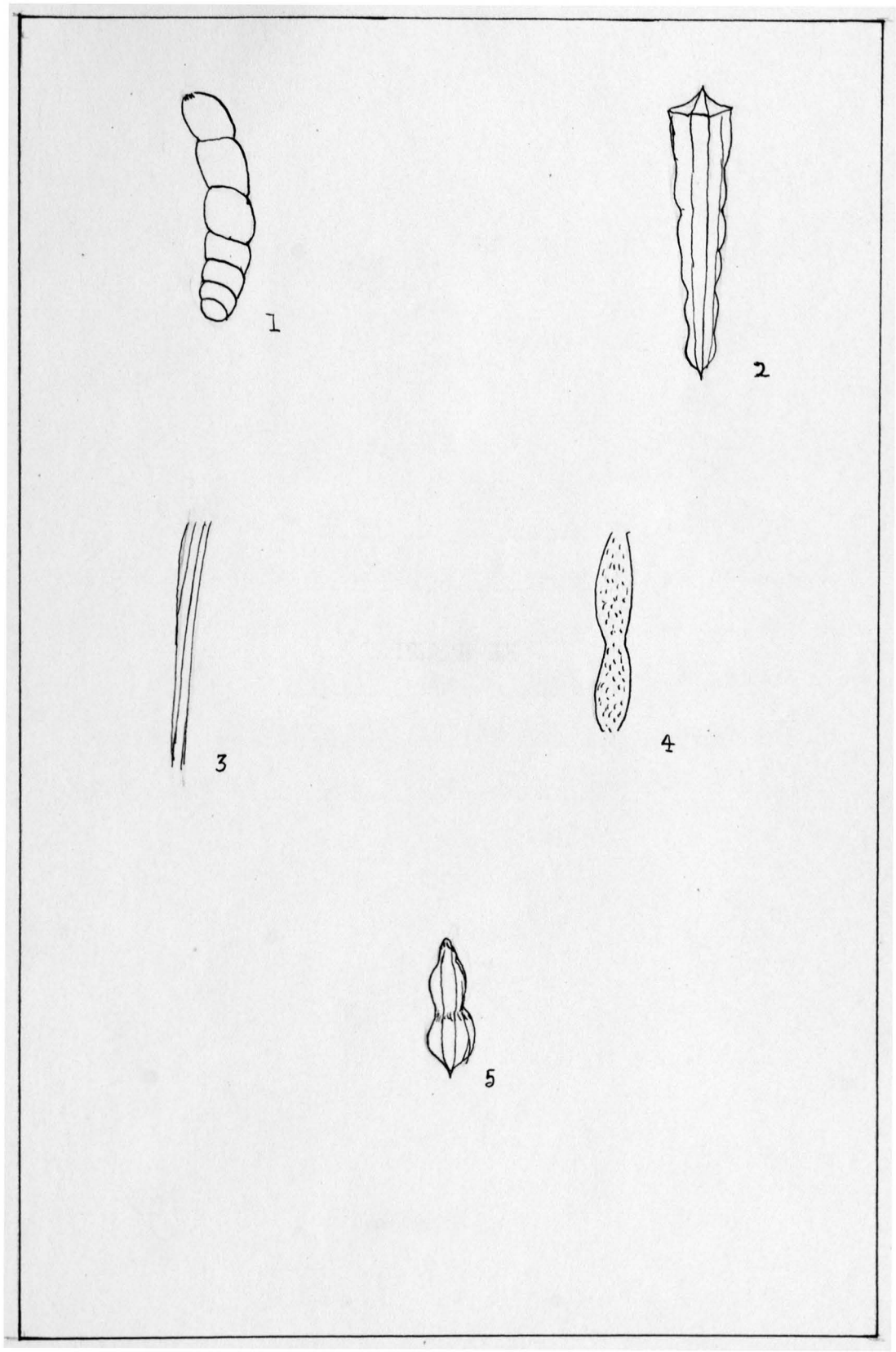

PLATE IX

PLATE IX

Figure 1. *Glandulina laevigata* d'Orbigny

Figure 2. *Robulus cultratus* Montfort

Figure 3. *Robulus reniformis* (d'Orbigny)

Figure 4. *Vaginulina webbervillensis* Carsey

Figure 5. *Vaginulina gracilis* Plummer var. *cretacea* Plummer

PLATE IX

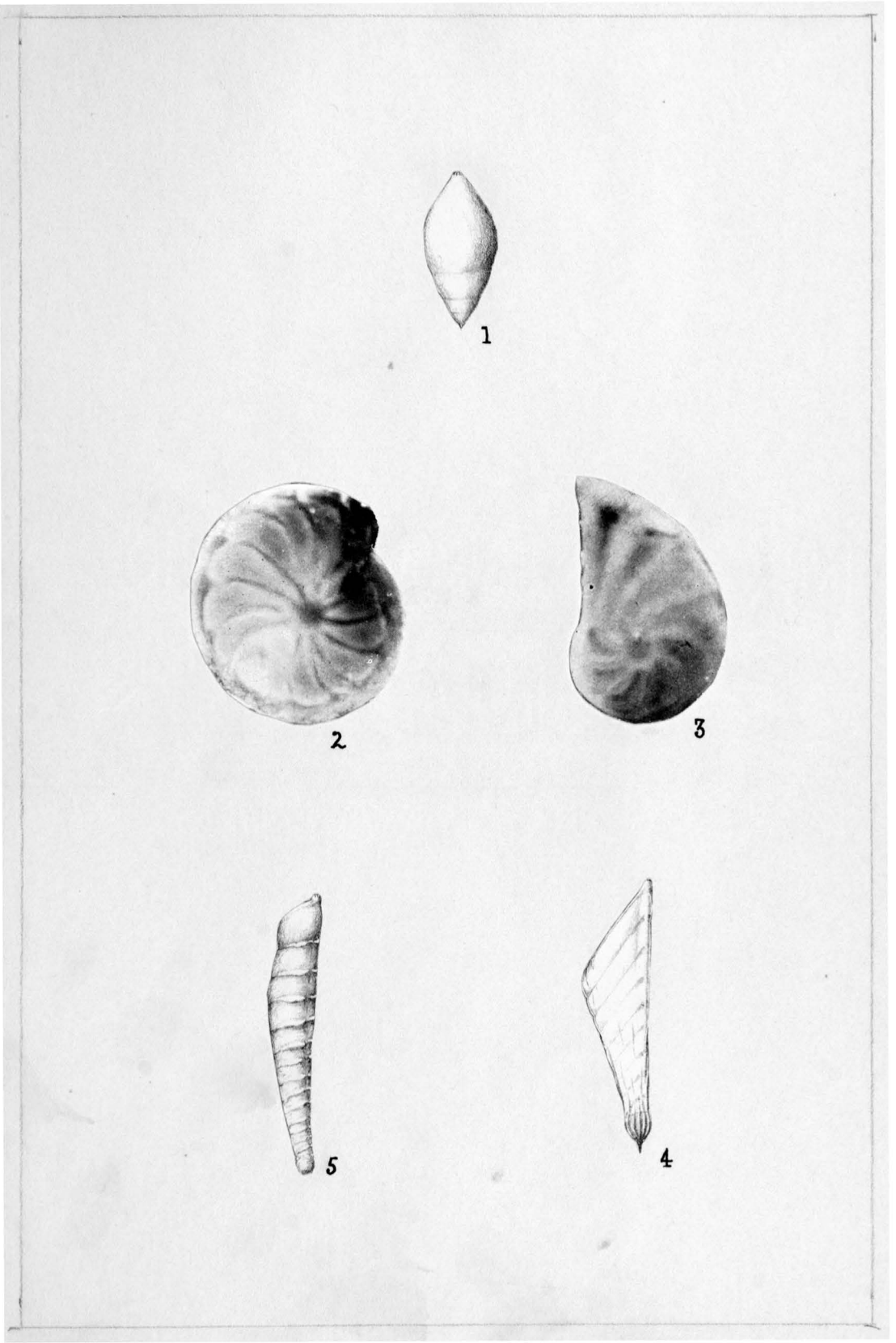

PLATE X

PLATE X

Figure 1. Nodosaria subverruculosa n. sp.

Figure 2. Nodosaria raphanus (Linné) var. fragilis n. var.

Figure 3. Vaginulina cuyleri n. sp.

Figure 4. Vaginulina ornata n. sp.

Figure 5. Vaginulina pretensa n. sp.

PLATE X

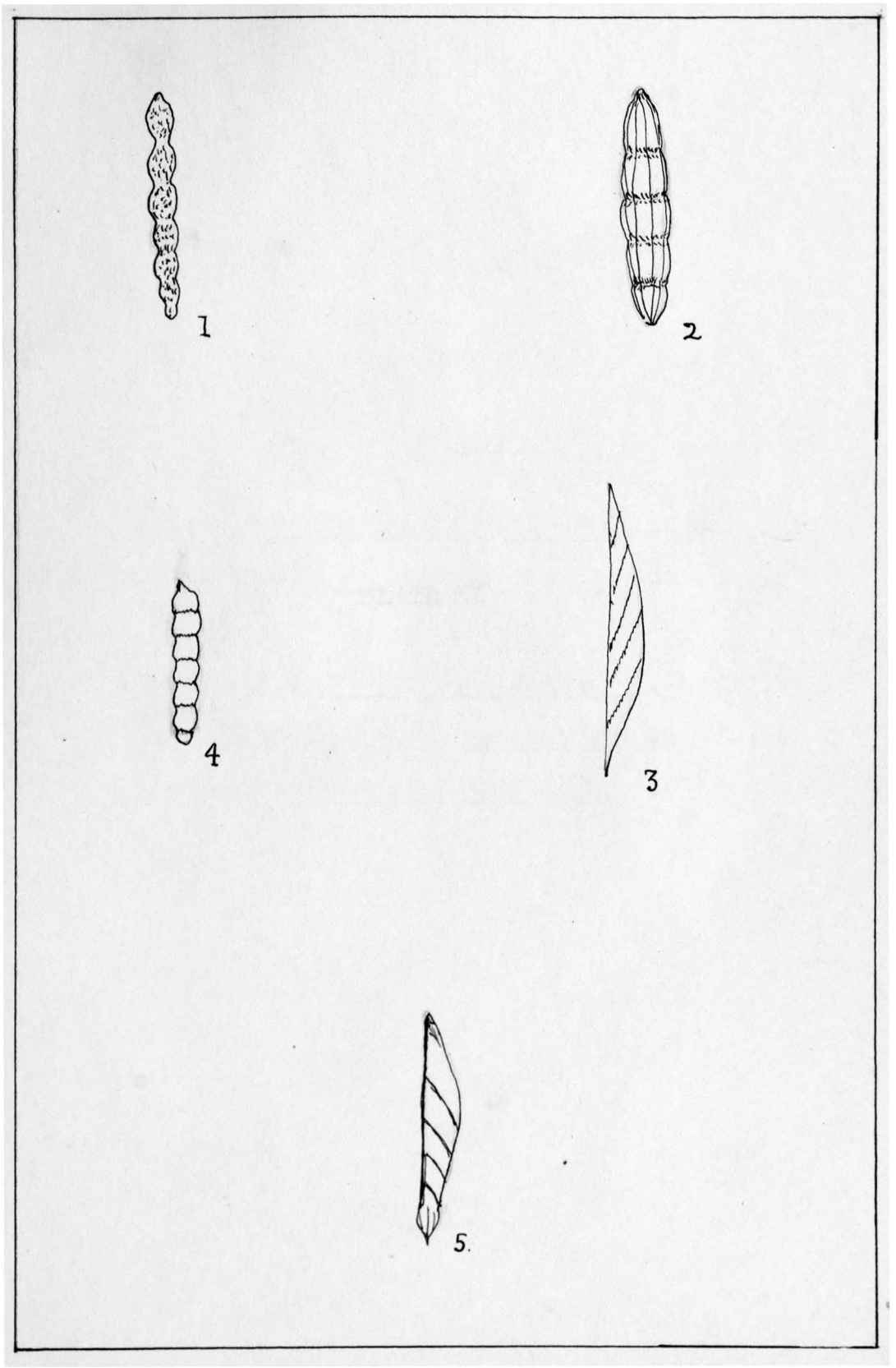

PLATE XI

PLATE XI

Figure 1. *Frondicularia oldhami* Plummer

Figure 2. *Frondicularia archiaciana* d'Orbigny var. *strigillata* Bagg

Figure 3. *Frondicularia reticulata* (Reuss)

Figure 4. *Frondicularia alata* d'Orbigny

Figure 5. *Flabellina rugosa* d'Orbigny

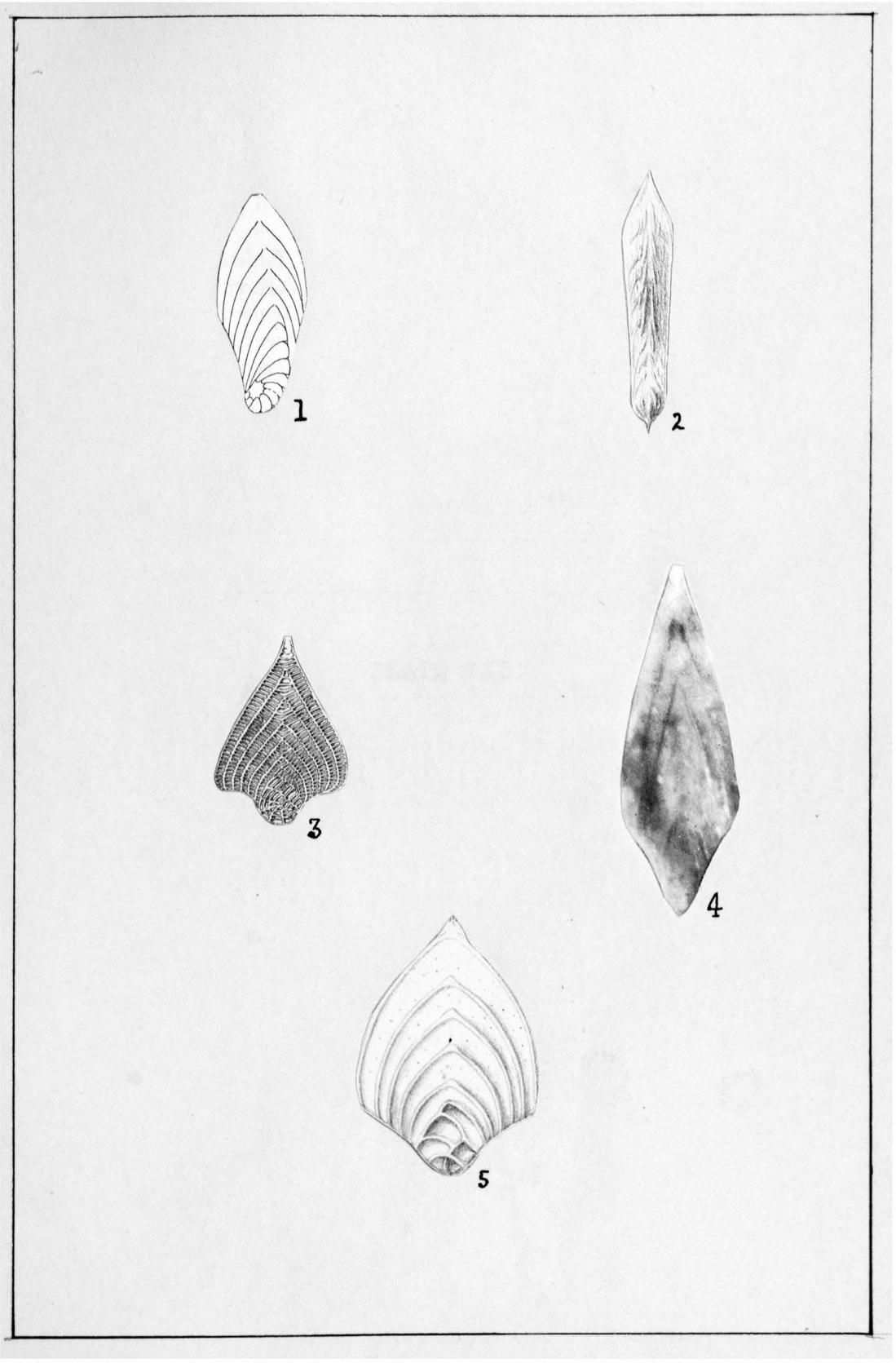
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PLATE XII

PLATE XII

Figure 1. Lagena incidenta Carsey

Figure 2. Lagena hispida Reuss

Figure 3. Guttulina communis d'Orbigny

Figure 4. Guttulina problema d'Orbigny

Figure 5. Guttulina oblonga (d'Orbigny)

PLATE XII

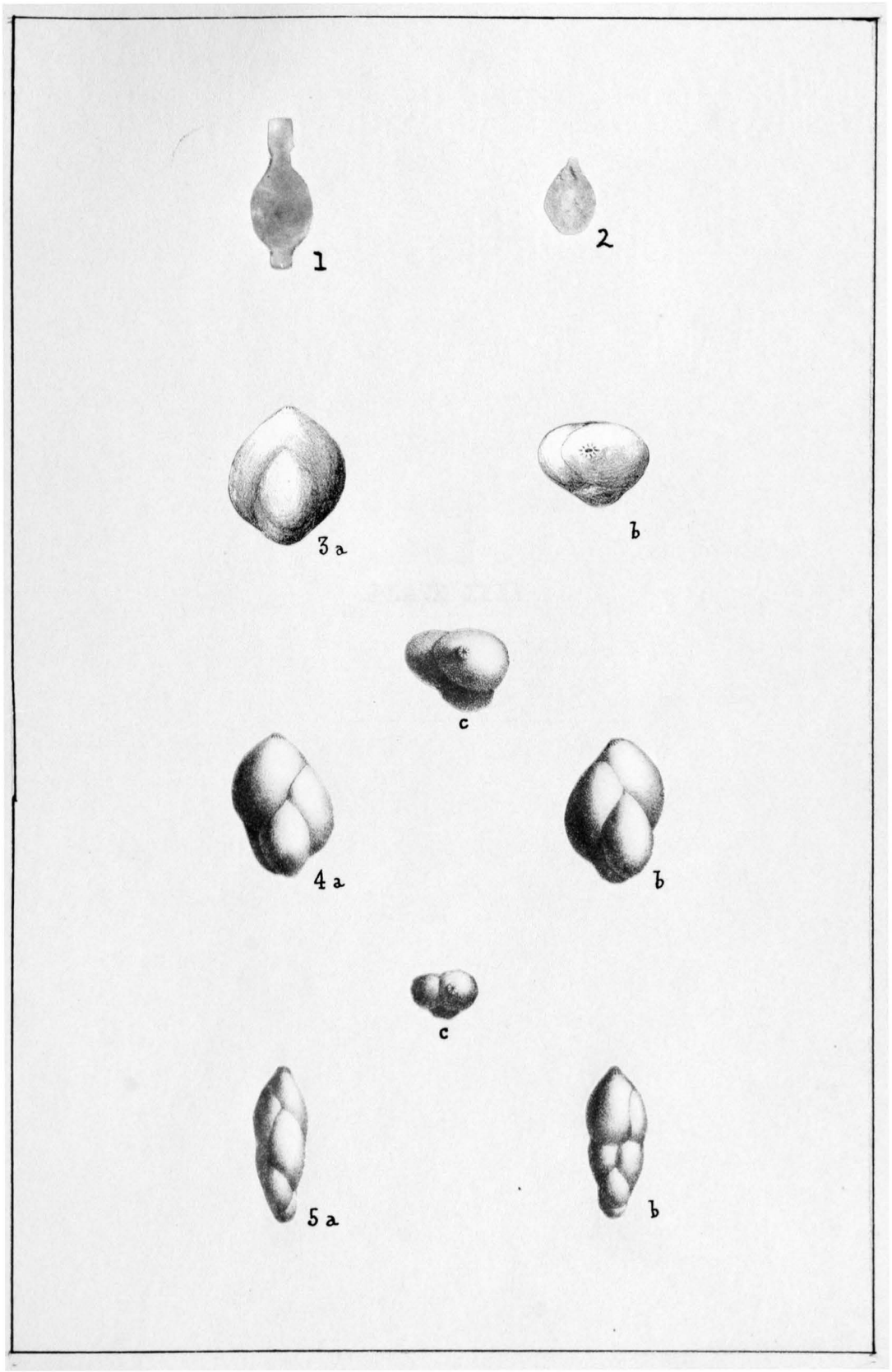


PLATE XIII

PLATE XIII

Figure 1. *Vaginulina brevis* n. sp.

Figure 2. *Planularia multistriata* n. sp.

Figure 3. *Lagena mucronata* Terquem and Berthelin

Figure 4. *Lagena brevispina* n. sp.

Figure 5. *Gyroidina soldanii* (d'Orbigny) var. *webbervillensis* a, dorsal view; b, side view.

PLATE XIII

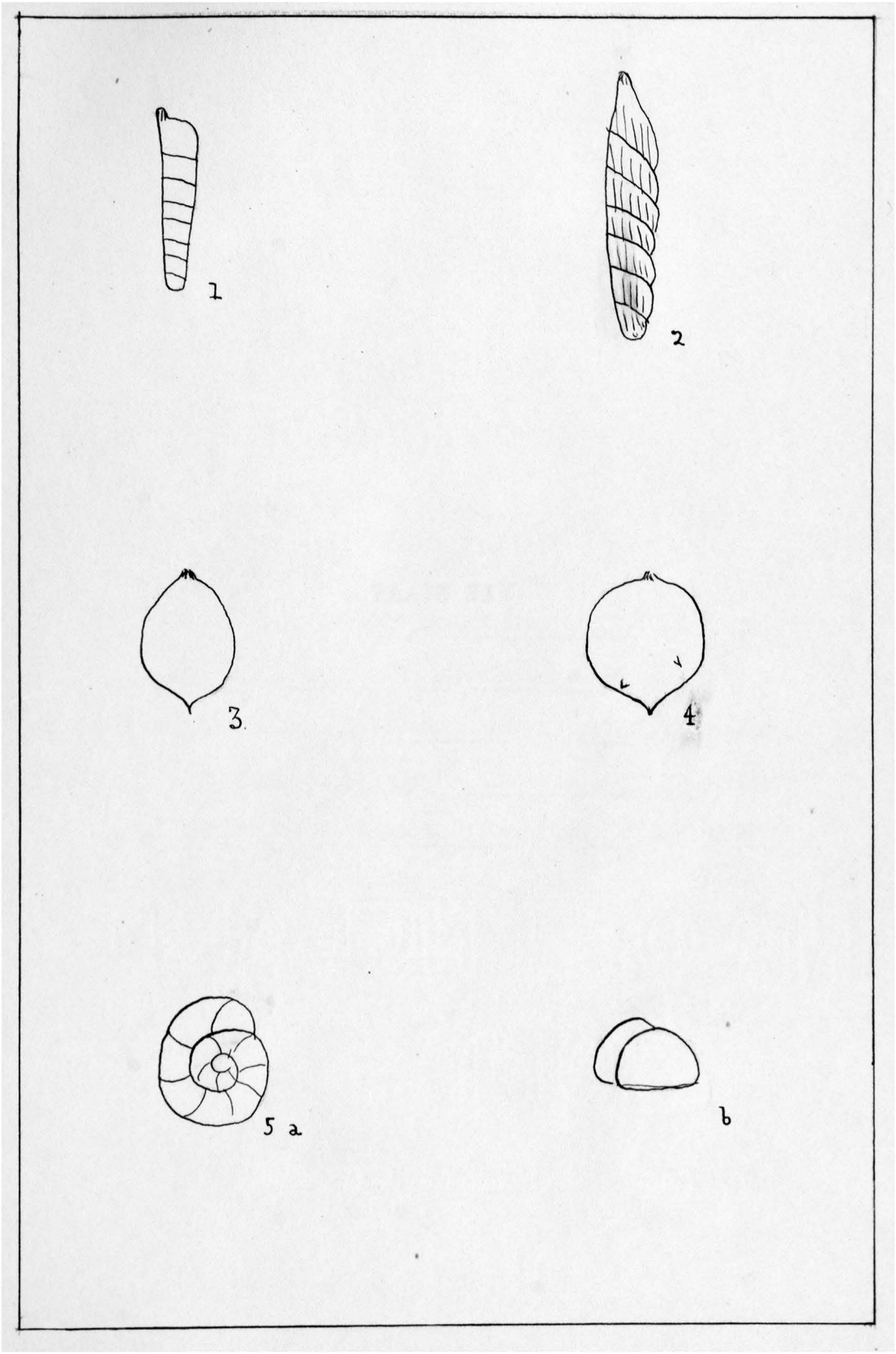


PLATE XIV

PLATE XIV

Figure 1. Globulina lactea (Walker and Jacob)

Figure 2. Globulina lactea (Walker and Jacob) fistulose form.

Figure 3. Ramulina sp.

Figure 4. Nonion turgida (Williamson)
a, side view; b, peripheral view.

Figure 5. Nonion scapha Fichtel and Moll
a, b, side views; c, peripheral view.

PLATE XIV

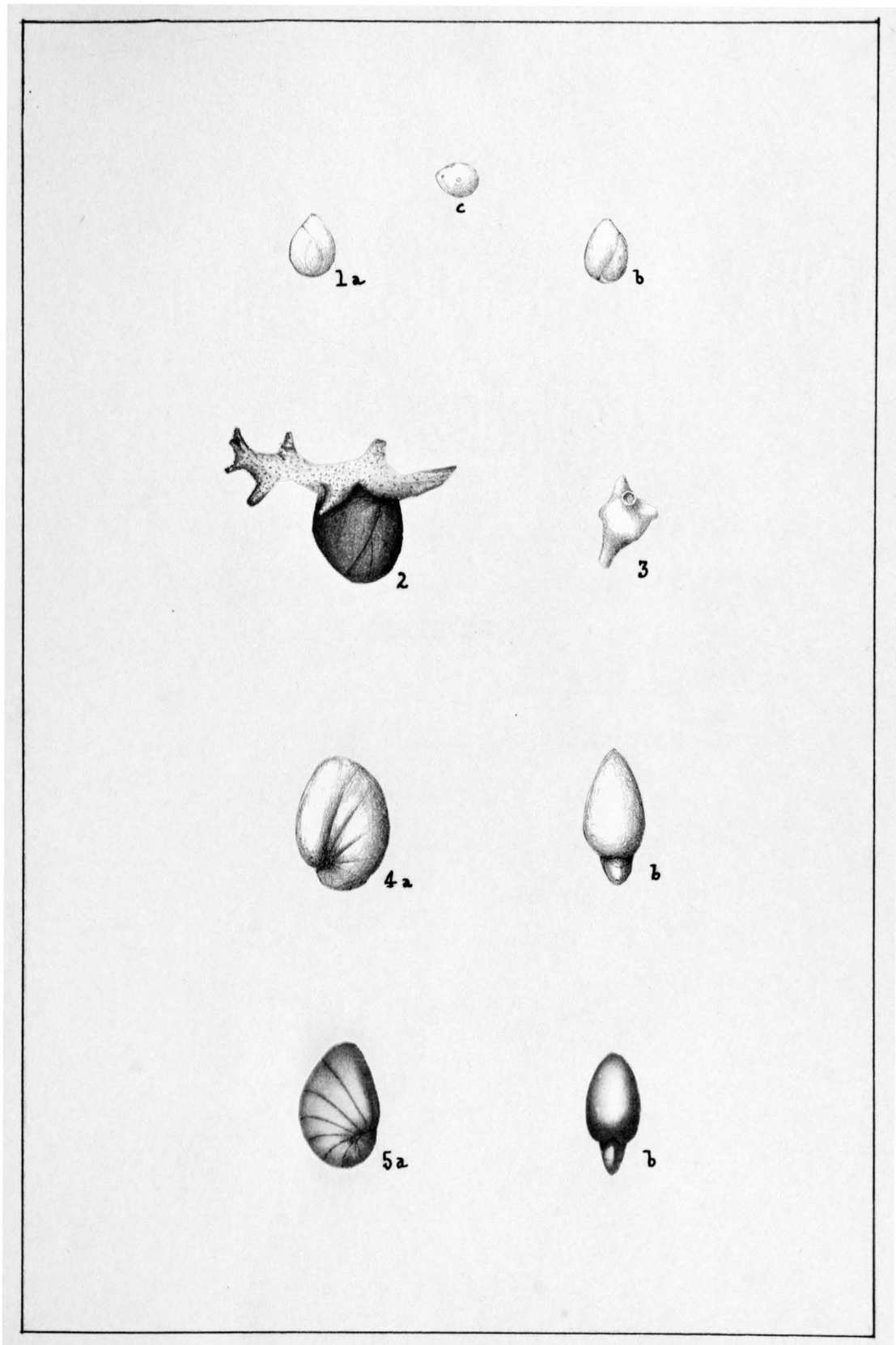


PLATE XV

PLATE XV

Figure 1. Guembelina globulosa (Ehrenberg)

Figure 2. Guembelina excolata Cushman

Figure 3. Pseudotextularia fracticosa (Egger)

Figure 4. Pseudotextularia compressa n. sp.
a, front view; b, edge view.

Figure 5. Pseudotextularia inflata n. sp.
a, front view; b, edge view.

1a

b

2

3

4a

b

5a

b

PLATE XVI

PLATE XVI

Figure 1. Pseudotextularia costata n. sp.

a, front view; b, edge view.

Figure 2. Pseudotextularia compacta n. sp.

a, front view; b, edge view.

Figure 3. Pseudouvigerina cristata (Marsson)

Figure 4. Bulimina pupoides d'Orbigny

Figure 5. Bulimina aculeata d'Orbigny

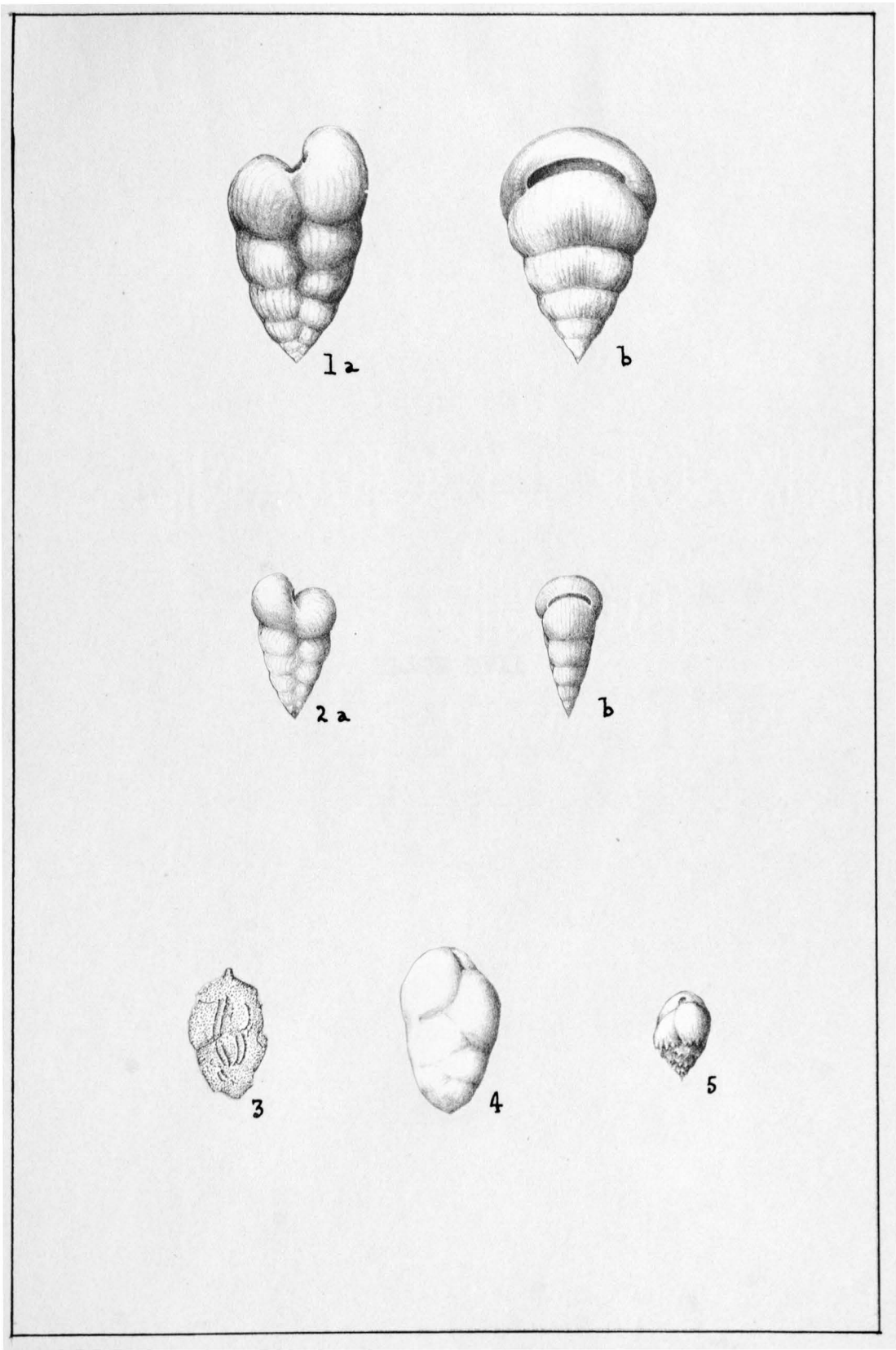

1a
b
2a
b
3
4
5

PLATE XVII

PLATE XVII

Figure 1. Bolivina gemma Cushman

a, front view; b, side view.

Figure 2. Bolivina tegulata Reuss

Figure 3. Bolivina incrassata Reuss

a, front view; b, side view.

Figure 4. Loxostomum plaita (Carsey)

a, front view; b, side view.

Figure 5. Discorbis correcta Carsey

a, dorsal view; b, ventral view.

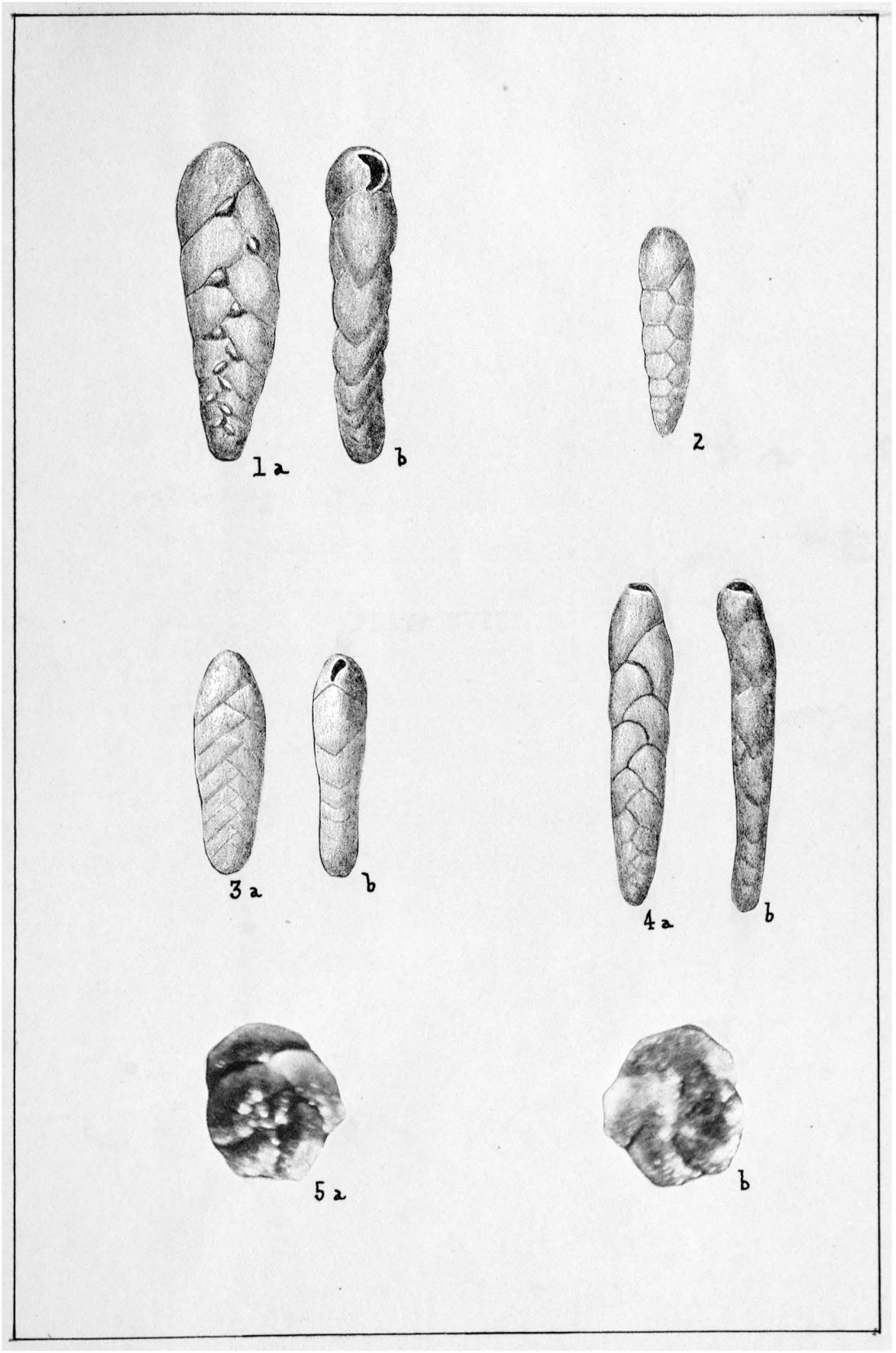

1a
b
2
3a
b
4a
b
5a
b

PLATE XVIII

PLATE XVIII

Figure 1. Rotalia cretacea Carsey

a, ventral view; b, dorsal view.

Figure 2. Rotalia aequilateralis Plummer

a, dorsal view; b, peripheral view; c, ventral view.

Figure 3. Epistomina partschiana (d'Orbigny)

a, dorsal view; b, peripheral view; c, ventral view.

Figure 4. Pullenia quinqueloba (Reuss)

a, dorsal view; b, peripheral view.

Figure 5. Globigerina cretacea d'Orbigny

a, dorsal view; b, ventral view.

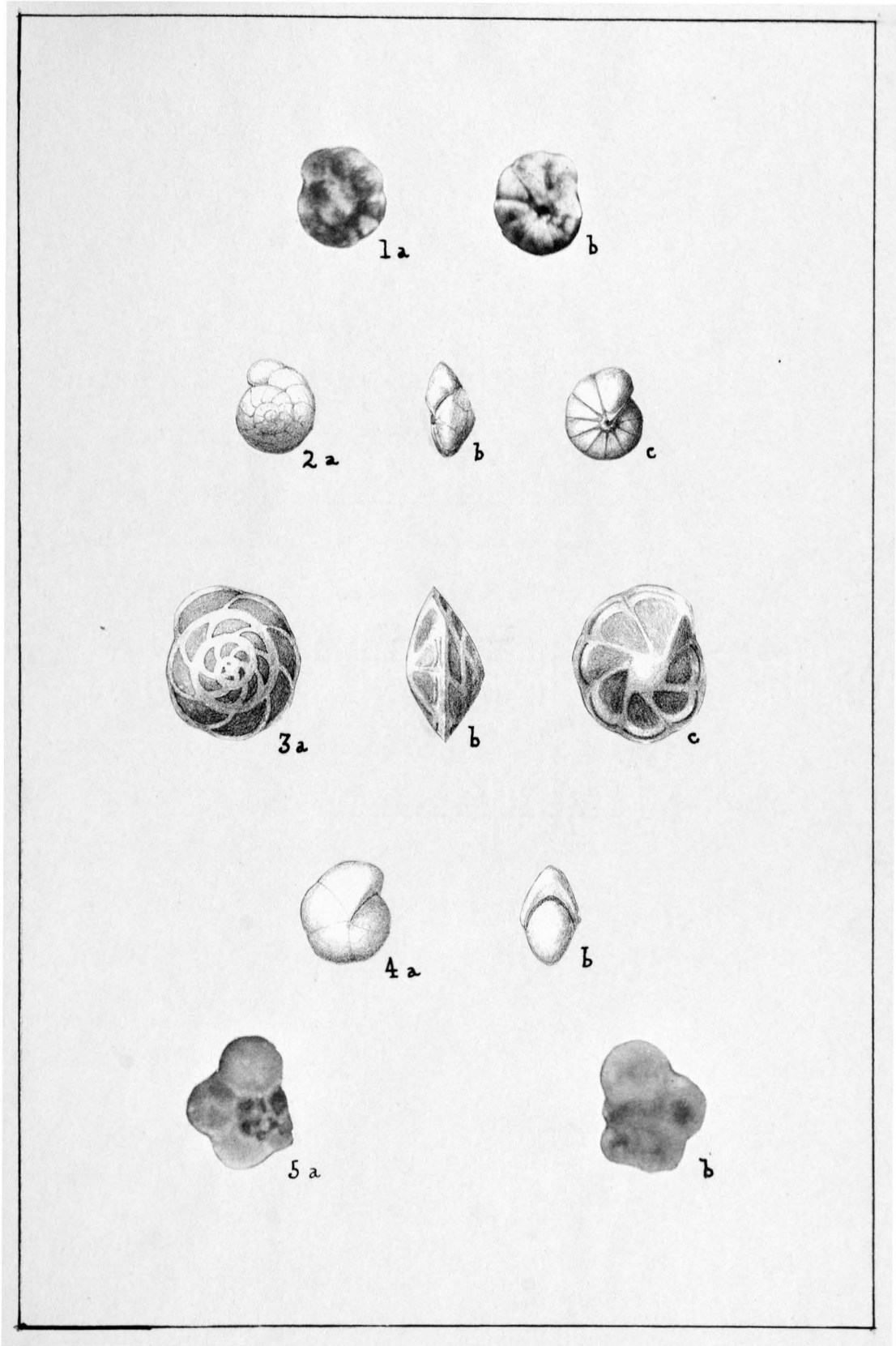

1a
b
2a
b
c
3a
b
c
4a
b
5a
b

PLATE XIX

PLATE XIX

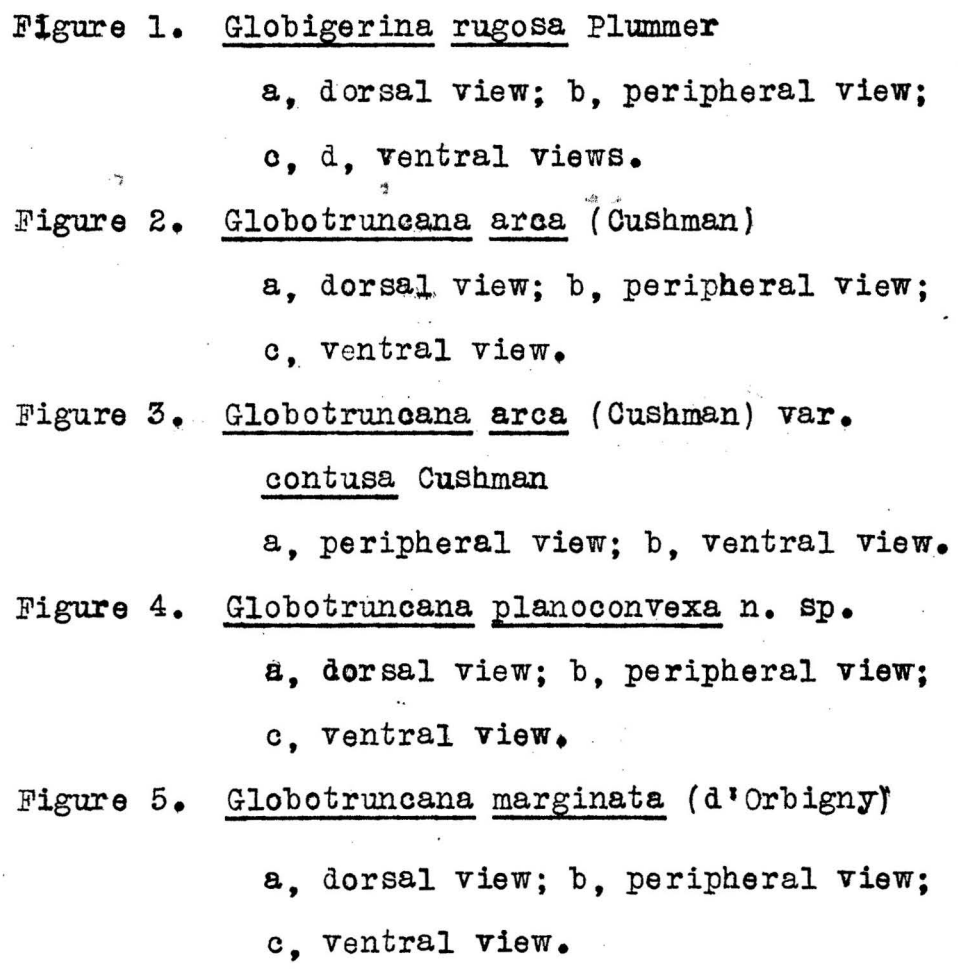


Figure 1. Globigerina rugosa Plummer

a, dorsal view; b, peripheral view;

c, d, ventral views.

Figure 2. Globotruncana arca (Cushman)

a, dorsal view; b, peripheral view;

c, ventral view.

Figure 3. Globotruncana arca (Cushman) var. contusa Cushman

a, peripheral view; b, ventral view.

Figure 4. Globotruncana planoconvexa n. sp.

a, dorsal view; b, peripheral view;

c, ventral view.

Figure 5. Globotruncana marginata (d'Orbigny)

a, dorsal view; b, peripheral view;

c, ventral view.

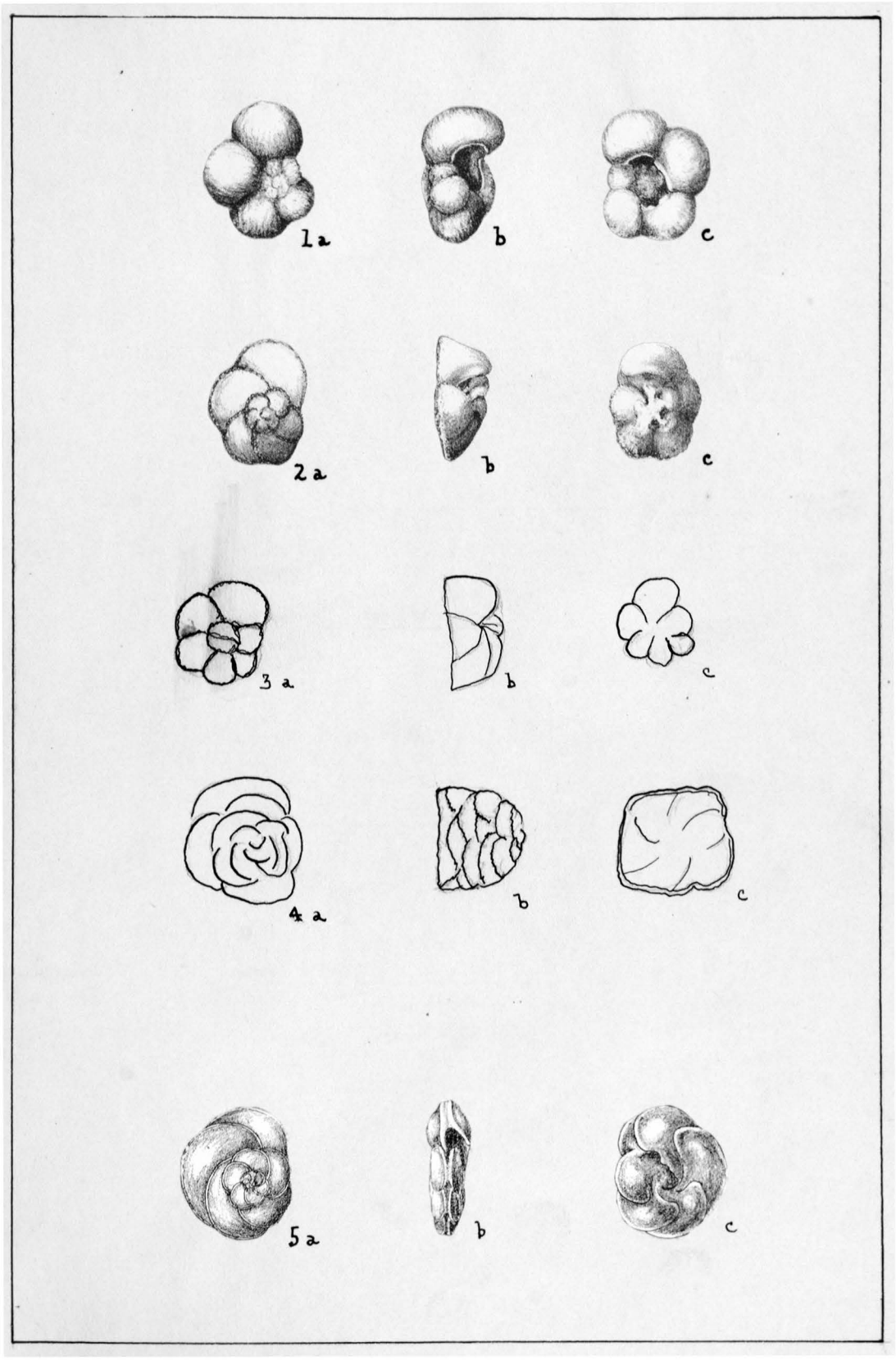

1a
b
c
2a
b
c
3a
b
c
4a
b
c
5a
b
c

PLATE XX

PLATE XX

Figure 1. Globotruncana caniculata (Reuss)

a, dorsal view; b, peripheral view;

c, ventral view.

Figure 2. Anomalina grosserugosa (Gümbel)

a, dorsal view; b, ventral view.

Figure 3. Anomalina pseudopapillosa Carsey

a, dorsal view; b, ventral view.

Figure 4. Anomalina navarroensis Plummer

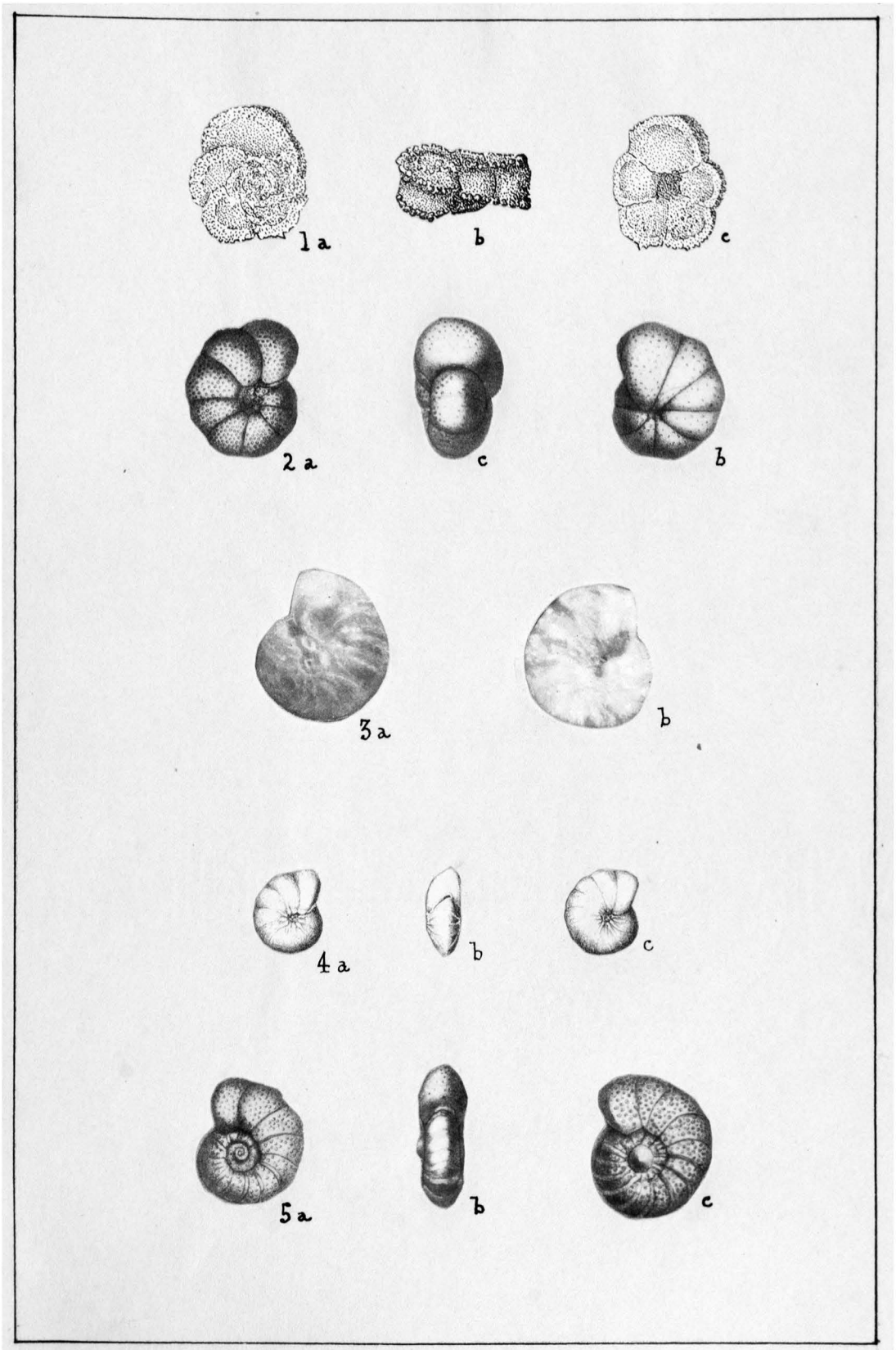
a, dorsal view; b, peripheral view;

c, ventral view.

Figure 5. Anomalina ammonoides Reuss

a, dorsal view; b, peripheral view;

c, ventral view.


1 a
b
c
2 a
c
b
3 a
b
4 a
b
c
5 a
b
c